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HOW TO GET STRONG.

(*Continued from page* 243.)

THE MUSCLES OF THE LEGS.

MANY seem to imagine that the muscles of the legs get all the development they require from walking, with such more active exercise as may be obtained from casual running, or an occasional game of lawn-tennis or the like. The result is that we seldom see the lower limbs nearly so well developed as they ought to be and very readily might be. Few muscles respond more quickly and satisfactorily to training than those of the legs, and though our costume does not, like that of the savage, allow the well-developed and shapely legs of the athlete to display their proportions very openly, yet even in that remarkable development of modern civilisation the "straight trousers" a well-formed leg (or preferably a pair) will manifest a marked superiority over ill-shaped lower extremities. It is not however, so much on the shape of the legs as on the grace and elegance of their movements that exercise tells most effectively. In the street and on the lawn, in the parlour and in the dancing-hall, the owner of active and lissome legs has a marked advantage over stiff and weak-legged beings. You will note the difference even in the way in which one or the other will stoop to pick up—let us say—a lady's fallen handkerchief. In all social exercises, within doors and abroad, the difference is marked. A man may be awkward with his arms, and no one will much notice the circumstance, but he who is stiff and awkward on his feet, shipwrecky about the knees, and cramped in the thighs, appears altogether ungainly and uncouth even if his arms, shoulders, chest, and waist are well developed and shapely.

The Upper Thigh.

Let us begin with the muscles of the upper thigh, taking first those in front.

The most easily obtained exercise for the front thigh muscles is fast walking. In this respect there is all the difference in the world between a quick walk and a slow one. Walking sharply, with the body held well upright, and taking hills with special energy, the thighs are well exercised; but in slow walking they hardly get any exercise at all. Running is good too, especially long distance running, with a long stride. Mr. Blaikie recommends that the heel should never touch the ground; but Mr. Muybridge's instantaneous photographs have shown that runners who believe that they run without bringing the heel to the ground do really touch the ground first with the heel, in the long striding run we are considering.

Maclaren regards jumping as the very best exercise for the legs. But it will be better to let each actual jump be an easy one, getting the exercise out of the number of jumps made rather than out of the effort required for each.

The following exercises should be practised daily by all who wish to have good thigh muscles.

First, standing upright with the feet close together, lower the body pretty sharply, till the tips of the fingers touch the ground on either side of the feet, on which spring sharply upright again. The heels rise in this exercise as the body descends. Repeat the dip from ten to twenty times. At first there is a tendency to topple over, but this will soon be corrected. (Note how the muscles and tendons in the knee regions are limbered by this exercise). The shoulders should be well squared as the body rises to the upright position. Gradually the dip may be carried farther until the whole inside of the finger part of the hands touches the ground, the body being sent up more sharply by the resulting pressure against the floor.

Secondly, go through similar movements, without lifting the heels from the ground. The hands now touch the ground a little farther forward, and as the dip increases, the backs of the fingers touch the ground, and even after awhile the backs of the hands as far as the wrists can be brought to the floor. The dips in this as in the preceding exercise should be made neatly and sharply,—in this way the knees get well exercised as do the calves and loins, while the quickened respiration shows how the chest takes part in the work.

Thirdly, both forms of exercise may be gone through with dumb-bells in the hands; and the dumb-bells thus used may be tolerably heavy.

Fourthly, there is a form of exercise for the upper thigh muscles which belongs rather to the nature of an athletic feat than to that of systematic exercise. It may therefore be used or let alone as may be preferred. It is not suited altogether perhaps to middle-aged gentlemen (or ladies) of obese tendencies:—Standing on the left foot, hold out the right leg at right angles to the body: now steadily sink till you are sitting on the left foot; you may perhaps sit unexpectedly on the floor, but persevere for all that, until you can comfortably sit down on one foot and steadily rise therefrom with the other leg all the time parallel to the horizon. When you can do this comfortably on either foot, you can invite your friends to do likewise, and if they have not practised they will interest you by their inevitable failures.

The upper thigh gets exercised also in the familiar feat of lowering the body on the left or right foot while the right or left foot is held by the right or left hand; the knee of the upheld leg being brought to the ground. This is in reality an easier exercise than the last; at least it always seemed so to me; though many who can do neither suppose this the harder: the difference between the two consists chiefly in the circumstance that in the former the sole of a foot rests all the time wholly on the floor, while in the latter the heel rises from the ground just before the knee touches it.

(*To be continued.*)

COINCIDENCES AND SUPERSTITIONS.

By Richard A. Proctor.

(*Continued from p.* 238.)

THE history of astronomy has in quite recent times afforded a very remarkable instance of repeated coincidences. I refer to the researches by which the theory has been established, that meteors and comets are so far associated that meteor systems travel in the track of comets. It will readily be seen from the following statements that the demonstration of this theory must be regarded as partly due to singular good fortune :—

There are two very remarkable meteor systems—the system which produces the November shooting-stars, or *Leonides*, and that which produces the August shooting-stars, or *Perseides*. It chanced that the year 1866 was the time when a great display of November meteors was expected by astronomers. Hence, in the years 1865 and 1866 considerable attention was directed to the whole subject of shooting-stars. Moreover, so many astronomers watched the display of 1866, that very exact information was for the first time obtained as to the apparant track of these meteors. It is necessary to mention that such information was *essential* to success in the main inquiry. Now it had chanced that in 1862 a fine comet had been seen, whose path approached the earth's path very closely indeed. This led the Italian astronomer Schiaparelli to inquire whether there might not be some connection between this comet and the August shooting-stars, which cross the earth's path at the same place. He was able, by comparing the path of the comet and the apparent path of the meteors to render this opinion highly probable. Then came inquiries into the real paths of the November meteors, these inquiries being rendered just practicable by several coincidences, as—(1) the exact observations just mentioned; (2) the existence of certain old accounts of the meteor shower; (3) the wonderful mastery obtained by Professor Adams over all problems of perturbation (for the whole question depended on the way in which the November meteors had been perturbed); and (4) the existence of a half-forgotten treatise by Gauss, supplying formulæ which reduced Adams' labour by one-half. The path having been determined (by Adams alone, I take this opportunity of insisting),* the whole question rested on the recognition of a comet travelling in the same path. If such a comet were found, Schiaparelli's case was made out. If not, then though the evidence might be convincing to mathematicians well grounded in the theory of probabilities, yet it was all but certain that Schiaparelli's theory would presently sink into oblivion. Now there are probably hundreds of comets which have a period of thirty-three and a quarter years, but very few are known—only three certainly—and one of these *had only just been discovered* when Adams' results were announced. The odds were enormous against the required comet being known, and yet greater against its having been so well watched that its true path had been ascertained. Yet the comet which had been discovered in that very year 1866—the comet called Tempel's, or I. 1866—was the very comet required to establish Schiaparelli's theory. *There* was the path of the meteors assigned by Adams, and the path of the comet had been already calculated by Tempel before Adams' result had been announced; and these two paths were found to be to all intents and purposes (with an accuracy far exceeding indeed the requirements of the case) *identical*.

To the remarkable coincidences here noted, coincidences rendered so much the more remarkable by the fact that the August comet is now known to return only twice in three centuries, while the November comet returns only thrice per century, may be added these :—

The comet of 1862 was observed, telescopically, by Sir John Herschel under remarkably favourable circumstances. "It passed us closely and swiftly," says Herschel, "swelling into importance, and dying away with unusual rapidity. The phenomena exhibited by its nucleus and head were on this account peculiarly interesting and instructive, *it being only on very rare occasions* that a comet can be closely inspected at the very crisis of its fate, so that we can witness the actual effect of the sun's rays on it." (This was written long before Schiaparelli's theory had attracted notice). This comet was also the last observed and studied by Sir John Herschel. Temple's comet, again, was the *first comet ever analysed with the spectroscope*.

It will be remarked, perhaps, that where coincidences so remarkable as these are seen to be possible, it may be questionable whether the theory itself, which is based on the coincidence of certain paths, can be accepted as trustworthy. It is to be noticed that, whether this be so or not, the surprising nature of the coincidences is in no way affected; it would be as remarkable (at least) that so many events should concur to establish a false as to establish a true theory. This noted, we may admit that in this case, as in many others, the evidence for a scientific theory amounts in reality only to extreme probability. However, it is to be noticed that the probability for the theory belongs to a higher *order* than the probability against those observed coincidences which rendered the demonstration of the theory possible. The odds were thousands to one, perhaps, against the occurrence of these coincidences; but they are millions to one against the coincidence of the paths as well of the November as of the August meteors with the paths of known comets, by mere accident.

It may possibly be considered that the circumstances of the two last cases are not altogether such as to assure us that special intervention was not in question in each instance. Indeed, though astronomers have not recognised anything supernatural in the series of events which led to the recognition of the association between meteors and comets, some students of archæology have been disposed to regard the events narrated by Dr. Young as strictly providential dispensations. "It seems to the reflective mind," says the author of the "Ruins of Sacred and Historic Lands," "that the appointed time had at length arrived when the secrets of Egyptian history were at length to be revealed, and to cast their reflective light on the darker pages of sacred and profane history. . . . The incident in the labours of Dr. Young seems so surprising that it might be deemed providential, if not miraculous." The same will scarcely be thought of such events as De Morgan recorded (and their name is legion); since it requires a considerable stretch of imagination to conceive that either the discovery of the name of a certain editor, or the removal of De Morgan's difficulties respecting the siege of Boston, was a *nodus* worthy of miraculous interposition.

For absolute triviality, however, combined with singularity of coincidence, a circumstance which occurred to me several years ago appears unsurpassable. I was raising a tumbler in such a way that at the moment it was a few inches above my mouth; but whether to examine its substance against the light, or for what particular purpose, has escaped my recollection. Be that as it may, the tumbler slipped from my fingers and fell so that the edge

* Leverrier, Schiaparelli, and others calculated the path on the assumption that the occurrence of displays three times per century implies a periodic circulation around the sun in about thirty-three years and a quarter; but Adams alone proved that this period, and no other, must be that of the November meteors.

struck against one of my lower teeth. The fall was just enough to have broken the tumbler (at least, against a sharp object like a tooth), and I expected to have my mouth unpleasantly filled with glass fragments and perhaps seriously cut. However, though there was a sharp blow, the glass remained unbroken. On examining it, I found that a large drop of wax had fallen on the edge at the very spot where it had struck my tooth, an indentation being left by the tooth. Doubtless the softening of the shock by the interposition of the wax had just saved the glass from fracture. In any case, however, the surprising nature of the coincidence is not affected. On considering the matter it will be seen how enormous were the antecedent odds against the observed event. It is not an usual thing for a tumbler to slip in such a way. It has not at any other time happened to me, and probably not a single reader of these lines can recall such an occurrence either in his own experience or that of others. Then it very seldom happens, I suppose, that a drop of wax falls on the edge of a tumbler and there remains unnoticed. That two events so unusual should be coincident, and that the very spot where the glass struck the tooth should be the place where the wax had fallen, certainly seems most surprising. In fact, it is only the utter triviality of the whole occurrence which renders it credible; it is just one of those events which no one would think of inventing. Whether credible or not, it happened. As De Morgan says of the coincidences he relates, so can I say for the above (equally important) circumstance, "I can solemnly vouch for its literal truth." Yet it would be preposterous to say that there was anything providential in such an occurrence. Swift, in his "Tale of a Tub," has indicated in forcible terms the absurdity of recognising [miraculous interventions in such cases; but should it appear to some of my readers that, trivial though the event was, I should have recognised the hand of Providence in it, I would remark that it requires some degree of self-conceit to regard oneself as the subject of the special intervention of Providence, and moreover that Providence might have contrived the escape in less complicated sort by simply so arranging matters that the glass had not fallen at all. So, at least, it appears to me in this case; and similar reasoning applies to other cases of the kind.

(To be continued.)

THE PLANET MARS.

MARS was doubtless one of the first among celestial objects whose planetary nature was recognised by ancient astronomers. It would be a question of purely speculative interest to discuss whether Jupiter or Mars was the first discovered planet. Despite the superior brilliancy of Venus, one or other of the two planets named must have been the object which first, after the sun and moon, was noticed as a wandering orb. For the circumstance that Venus was known originally under two names, suffices to prove—what, indeed, might be anticipated independently—that the ancients failed at first to recognise the brilliant stars of evening and morning as one and the same object. Jupiter second only in brilliancy to Venus at her brightest, and, unlike her, resplendent during the darkest hours of the night, must have attracted the attention of men, as soon as they commenced to notice the stars at all. Yet his motion among the fixed stars might have escaped the notice of astronomers for some little time—because, although sufficiently conspicuous when attention is directed to the planet for several weeks, the motion does not in a few days produce a marked change in the position of the planet. Mars, less brilliant than Jupiter, yet shines, at times, more brightly than any of the fixed stars, and his ruddy tint serves to render his appearance more remarkable than it would otherwise be. Once noticed with attention, even for a few days only in succession, Mars must have been recognised as a planet, since he moves rapidly among the fixed stars. On this account he might possibly have preceded Jupiter as respects the epoch of his recognition as a planet. On the other hand, there is a circumstance in Jupiter's favour—that he comes to opposition at intervals of thirteen months and shines brightly for several months preceding and following opposition; whereas, Mars only comes to opposition at intervals of about twenty-six months, and the brilliancy with which he shines when in opposition is quickly attained and as quickly lost. On the whole, the probability is that the discovery of Jupiter's nature preceded by a few months that of Mars. The date of each discovery must undoubtedly be placed in the remotest antiquity.

At an early period the planet Mars was noted by astronomers as distinguished from his fellow-wanderers by several remarkable peculiarities. I have already mentioned the rapid variation of brilliancy recurring during the progress of each opposition—by which term I refer to the interval (of several months) in about the middle of which opposition takes place. But this is not the sole, nor the most noteworthy peculiarity affecting the brilliancy of Mars. For whereas in *different* oppositions the planet Jupiter was noticed to present always about the same degree of brilliancy, Mars was observed to be very variable in this respect: at some oppositions he approached the planet Jupiter in brilliancy, at others he scarcely exceeded Saturn. A recurrence of several brilliant oppositions followed by a recurrence of several in which the planet's light shone less brightly, was also a phenomenon noticed by ancient astronomers. They do not appear to have detected the fact that the brilliancy of Mars was always greater when he came to opposition in one particular region of the Zodiac. Nor do they seem to have noticed the period—on an average about sixteen years—which seemed to belong to the cycle of variation.

Another circumstance which at an early epoch attracted the notice of astronomers, was the variability in the interval separating successive oppositions of the planet,—or, in other words, the variable synodical period of Mars. Slight variations might have been noticed in the synodical periods of other planets,—but nothing approaching the remarkable variability of Mars in this respect. The consideration of the orbit of Mars, and of his motion therein, on which this peculiarity and those noted in the planet's variation of brilliancy will be found to depend, is left to another occasion.

Mars, shining with a ruddy light, which waxes and wanes in a striking yet mysterious manner, was selected in very ancient times as the planet of war. Astronomers selected for their symbol the shield and spear of the warrior of ancient times—a selection alluded to by Tennyson in the lines describing how in a vision Maud—

> She pointed to Mars
> As he glowed like a ruddy shield on the Lion's breast.

It may be remarked that that was said in 1863, and now again—

> Mars glows like a ruddy shield near the Lion's heart.

Astrologers assigned to Mars an influence corresponding to his association with war and warlike ideas. A person born when the influence of Mars was in the ascendant, was supposed to be characterised in a marked degree by those

virtues and defects which have been associated from time immemorial with the martial character. Alchemists considered the metal iron to be placed under the special influence of Mars. The association is probably very ancient, far preceding, doubtless, the period to which the invention of alchemic arts is usually assigned. In the present day the association seems very natural, when it is considered how largely iron enters into the construction of nearly every warlike weapon. But of old this was not so, and it is possible that other associations than those connected with the employment of iron were assigned to Mars. It is not improbable, however, that this happened later, and when the advantages of the use of iron in the construction of warlike weapons were beginning to be recognised.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

FAMILIES who possess a microscope should acquaint themselves with the appearance and structure of a variety of objects which are used in common life. Often an agreeable surprise is the result, and astonishment is always expressed when attention is directed to the scales of fish. There is a good deal of contradiction and inaccuracy in many books on this subject. The fish-scales were, and are still sometimes represented as products of the cuticle or epidermis, and a great and fundamental difference is affirmed between these formations and the scales of snakes. In some books it is said that snakes shed their scales with their skin; but the fact is, as stated by Mr. C. Cooke, in his useful little book, "Our Reptiles," that the cast-off skin is a thin delicate cuticle, which had covered all the projections and inequalities of the true skin, containing a little pouch for each of the scales." Mr. Edward Newman put the matter well when he explained that, while the outer skin of quadrupeds is clothed with hair, that of birds with feathers, of fishes with scales, in reptiles it is uncovered and naked. They are also not deciduous, as hairs, feathers, and some scales are. Newman was one of the first, if not the first, to point out that the snake's scales are projections, folds, or rugosities of the under skin. In the growth of the various fish-scales, Sir R. Owen tells us "the chief seat of vascularity, and greatest activity and variety of development, is at the periphery of the derm (true skin) between it and the epiderm (cuticle).

In the eel the scales are not seen, unless the skin is well cleaned and viewed as a transparent object, or the soft epiderm, or outer skin, is scraped off, and the scales taken out of the derm. They then appear very pretty objects with a magnification of 50 or upwards linear. They are only two or three lines long, and exhibit a network of cartilaginous fibres. Polarised light and selenite invest them with beautiful colours. The sand-eel skin is a very instructive subject when mounted in balsam. The scales are rather larger, some distance apart, and both skin and scale glow with blue, gold, and crimson, or other colours, under the polarising treatment.

Agassiz divided fishes in a manner very convenient for the geologist studying their fossil remains, into groups characterised by varieties of scale.

The pike affords a good example of the cycloid scale, which is roundish, with radiating and concentric lines of considerable beauty. The ctenoid (or comb scale) is found in the perch, and the sole, whose skin is remarkably beautiful as an opaque object, with its rows of scales exhibiting series after series of brilliant, glassy-looking and radiating teeth projecting out of the skin. Fig. 1, from "Micrographic Dictionary," gives some idea of its appearance, but engraving cannot render the effects of light upon it.

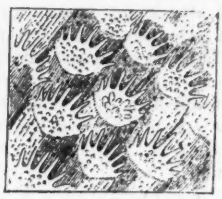


Fig. 1.

Fig. 2.

The ganoid (shining or glittering) scale is a decidedly bony formation, with an enamelled surface, which has been called ganoin. This substance, Owen says, is usually confined to two-thirds of the outer surface of the scale. Most of the fish with these scales are extinct, but common as fossils. Such scales often supplied a complete armour-suit for their wearers, and the small ones of Pholidophorus—a species common at Lyme Regis—make interesting objects for a microscope, and should be compared with a section of recent bone. The placoid scales in Agassiz's system are often of great beauty. They have projecting teeth springing from a firm plate. The skin of the spotted dogfish seen as an opaque object is extremely elegant. Innumerable rows of brilliant crystalline-looking projections reflect the light. Their shape is shown in Fig. 2. Some of the sharks with this kind of skin afford the well-known shagreen, now neglected by fashion, but which is a very strong and beautiful substance for many ornamental purposes, especially the fine green kind, with white projections.

Couch, in his "Fishes of the British Islands," describes the sturgeons—the general texture of whose skin is soft and thickly covered with mucous pores—as having bony plates of the placoid sort on their sides and head, and he quotes Owen, who considers this armature acts as ballast by its weight, as well as protecting the creature against blows from stones and other objects thrown by currents against it as it grovels amongst the decomposing matter at the bottom of shoal water. The brain is specially protected against injury, and the weight of the armour compensated by a large expansive air-bladder, which facilitates its rising in the water whenever it requires.

Dr. Mandl showed that the growth of the projecting teeth of fish-scales was carried on like that of real teeth. An account of his researches is given in Tod's "Encyclopædia of Analogy and Physiology," with a copy of his illustration as in Fig. 3, which exhibits these teeth from a rudimentary to a final stage.

An interesting account of fish-scales is given in Gosse's excellent "Evenings at the Microscope." As an illustration of the cycloid sort he takes the gold-fish, and gives sketches of their different shapes. On carefully detaching a scale, he finds, on the under side, a layer of soft gleaming substance, silver or golden, according to the hue of the fish. Spreading a little of the substance on glass, in a water-drop, and viewing it with a power of 300 linear, he discovers an infinite number of flat, oblong prisms, or crystals, so transparent as to be scarcely seen in transmitted light, but flashing in reflected light. The colour is not caused by them, but by pigment cells, amongst which they shine. When seen in the water-drop, he describes each spiculum

vibrating and quivering as if with spontaneous motion, and he supposes in the living creature a certain freedom of motion of these objects produces "the beautiful pearly play of light that marks these lovely fishes as distinguished from the light reflected by a uniformly polished surface."

Fig. 3.

Mr. Gosse also describes the aspects of a scale of the green wrasse seen with × 600, both flat, and at the cut edge of a longitudinal section made with fine sharp scissors. The upper layer he regards as formed by successive deposits from beneath, "but after a few have been deposited, they begin to slit, probably by contraction in becoming solid; and the lower layer is formed after each upper one is hardened, exceeding its length by a little and filling up the slit; then this lower layer becomes the upper layer of the next course, slitting, and turning up its terminal edge as it hardens, and so on as long as the fish lives." In the pike he finds "the portions separated by slitting, instead of expanding and leaving spaces to be filled up, actually close over each other."

Owen describes the scales of the Lacertians (lizards, &c.) as thickened epiderm or horn. In crocodiles, he says, "the conversion of parts of the integument into bone is constant, and the osseous structure shows interlaced or crossing fibres, like that of the derm in and from which the scales are developed."

In dealing with fish-scales for the microscope, the more delicate kinds may be mounted whole in Canada balsam; others may be split; but the ornamental skin of the rays, dogfish, &c., should be well cleaned and mounted in open wooden cells, only covering a rare kind with glass. In some fishes a powerful weapon of attack and defence is formed in a manner like Dr. Mandl's sketch. The sting-ray of our coasts has, about two-thirds from the end of its tail, a most formidable jagged dagger, a wound from which is very serious, and was deemed fatal by the ancients.

THE MORALITY OF HAPPINESS.

A Study of the Scientific Aspect of Conduct.

By Thomas Foster.

CARE OF OTHERS AS A DUTY.

(*Continued from p. 242.*)

THE relations within a family present on a small scale a picture of the relations among the members of a race or nation, as these in turn present a miniature of the relations between the different races and nations which form the human family. As men rise in the scale of being, they pass from the sense of duty within the family to the sense of duty between man and man throughout society, and thence—though as yet this development is very limited—to the sense of right between different races and nations. We have seen that undue care of self is self-injurious and eventually must be self-destructive in the family. There is a corresponding law for undue care of self in social relations, as there is, (however persistently at present the vast majority of men overlook or fail to see the fact) for undue regard of self among the nations. We may mistakenly regard undue care of self in the body social as cleverness, aptitude for business, and so on; and we may mistakenly regard national selfishness as patriotism: but the process of evolution is as certainly working towards the elimination of one as of the other form of undue egoism.

The main condition of social welfare and of social progress, is that the union which society implies shall work for the benefit of those associated. If the balance of effects resulting from association be evil, the body social must inevitably dissolve in the long run.

Now by laws of greater or less severity the members of a race or nation may be compelled to recognise each others' claims. Or such recognition may be assured by the fear of retaliation if the claims of others are neglected. In such cases, however, the gain to each, or the egoistic advantage of association, is small. Enforced recognition of altruistic rights is in itself disagreeable. The more disagreeable it is the oftener will cases arise where the laws have to be called into operation (and their operation is by our supposition painful), or where retaliatory action is aroused, with waste of energy and disagreeable effects on either side. A society so restrained is held together by but weak bands, and is ill-fitted to support itself against external enemies. Internal co-operation for the benefit of the community cannot be active under such circumstances. The products of labour are insecure. Moreover whatever has to be done in the way of self-protection or of the safeguarding of property is so much withdrawn from the advancement of the general interests of the body social.

We have only to consider the condition of any European country, our own included, in the good old times which so many ignorant persons regret as a sort of golden age, to see how unsatisfactory must be the state of a nation in which only a stern code of laws, or the dread of retaliation, protects each against the undue egoism of his fellows. Internal wrongdoing and the necessity for constant struggle to resist such wrongdoing, made each nation unstable. Our good old England was invaded and conquered over and over again in consequence of instability so produced. From long before the invasions by Saxon hordes under pirate chieftains to long after the invasion by Normans under the bastard descendant of the pirate chief Rollo, England was made wretched and miserable by constant contests, having their origin invariably in that undue egoism which we now call rapine and plunder. None—not even the most powerful—were secure. The castles we find so picturesque and romantic, the battles which seem so glorious, the chivalry in which we see so much splendour, all tell us of a state of barbarism, of abject misery for the majority of magnificent discomfort for the powerful. In the unsafety of those days, however, resided the certainty that the undue egoism of "the good old times" would by a natural process of evolution be eliminated. It is not yet fully eliminated; probably centuries will elapse before it is even in great part got rid of; but it is manifestly much reduced. We still have laws to protect us against wrongdoing, but the worst wrong-doers—those who of yore were the principal component parts of the body politic—no longer exist in the same way as of old. A much larger proportion of the social body recognise regard for others as a duty; no inconsiderable proportion recognise it as a pleasure; and what

is of more importance still, men recognise the advantage of encouraging these changed tendencies.

These changes have come on so gradually that few consider how important they really are. It is not too much to say that a large proportion of the Englishmen of our day would find life not worth living if the old state of things were restored, if, for instance, life and property and reputation became as insecure now as in the days of the Plantagenets, the Tudors, or even the Stuarts.

And here it may be noticed that those who neglect the consideration that they form part of the social body and refrain from the taking due part in maintaining a healthy social state suffer from the defective arrangements which they permit to remain uncorrected. We see this in very marked degree in America though it can be recognised clearly,—far too clearly,—in our own country. There the best men keep out of politics for a reason which rightly understood should make all the best men take most anxious interest in politics. Because in America offices are too often filled by mere adventurers, because bribery and corruption are rife, and because fraudulent conduct is common among politicians, therefore should it be held the duty of every right-minded American to do his best to enforce the wholesome changes so obviously required,—as they might be enforced if so many of the best Americans were duly altruistic. But as a matter of fact the very circumstance which should arouse all the best in America to vigorous action is made the chief reason for withdrawing from public duties.

In our own country the same undue egoism shows itself in another and a scarcely less mischievous form. The individual members of the community find relief in the thought that social duties may be handed over to government. It seems easier to talk laws into existence for getting things done, than to do them. The laws are easily passed, but the doing of what is necessary passes in a great number of cases into the hands of men not nearly so much interested in the doing of it as those who passed the laws appointing them to the work,—nay often, by the very nature of the laws so passed, interested rather in delaying than in pushing on the work.

As Mr. Spencer well puts it, the man who thus shirks the duties which he owes to the community of which he forms part, who plumes himself on his wisdom in minding his own business, "is blind to the fact that his own business is made possible only by maintenance of a healthy social state, and that he loses all round by defective governmental arrangements. When there are many like-minded with himself—when as a consequence, offices come to be filled by political adventurers, and opinion is swayed by demagogues—when bribery vitiates the administration of the law and makes fraudulent State transactions habitual; heavy penalties fall on the community at large, and among others on those who have thus done everything for self and nothing for society. Their investments are insecure; recovery of their debts is difficult; and even their lives are less safe than they would otherwise have been. So that on such altruistic actions as are implied, firstly in being just, secondly in seeing justice done between others, and thirdly in upholding and improving the agencies by which justice is administered, depend, in large measure, the egoistic satisfactions of each."

Apart from dangers directly affecting life and property, those resulting from undue egoism in business relations show the necessity of just altruism for the welfare and happiness of the social body. Not only is it well for each to recognise the rights of others, but each is interested in securing due recognition of altruistic rights by his fellows. The evils resulting from business frauds affect the welfare of the community. To quote the illustrative cases cited by Mr. Spencer, "the larger the number of a shopkeeper's bills left unpaid by some customers, the higher must be the prices which other customers pay; the more manufacturers lose by defective raw materials or by carelessness of workmen, the more must they charge for their fabrics to buyers. The less trustworthy people are, the higher rises the rate of interest, the larger becomes the amount of capital hoarded, the greater are the impediments to industry; the further traders and people in general go beyond their means, and hypothecate the property of others in speculation, the more serious are those commercial panics which bring disasters on multitudes and injuriously affect all."

(*To be continued.*)

THE UNIVERSE OF SUNS.

By Richard A. Proctor.

(*Continued from page* 225.)

IN the papers which appeared in the years 1817 and 1818 Sir W. Herschel showed much of his former strength, but little of his former elasticity of mind. He clearly indicates the lines of inquiry by which certain results should be sought, and he travels with zeal and energy along those lines, but he no longer seems ready as of yore to explore the neighbouring country in order to recognise whether he has chosen the best paths, nor does he seem to recollect that he had already travelled along certain portions of these paths and had been led to recognise long since that they are not to be regarded as altogether trustworthy roads. We cannot wonder, considering that Herschel was now nearly eighty years old, that he should thus begin to show signs of failing elasticity, dimmed vision, and clouded memory. So far is it from being unfair to his memory to notice the change, that—in my judgment—it seems only just to him to ask that these two last papers written in extreme old age should not be allowed to outweigh the conclusions of his matured judgment when his wonderful powers of observation were still in full vigour, while age had not yet touched or impaired the singular clearness and versatility of his reasoning. After all he worked with apparently full power up to his seventy-fifth year, and it is only in the two closing papers of the marvellous series contributed by him to the records of the Royal Society that any diminution of his energies can be noticed.

We have seen that after long and careful study of the Milky Way, Sir William Herschel had become convinced that the stars forming that region of the stellar system are very differently arranged from those in our immediate neighbourhood which form the scattered stars of our constellations. He recognised also that the rich regions of the Milky Way, where rounded aggregations of stars are seen, are real cloud-like regions of star-strewn space drawn apart, so to speak, so as to be surrounded on all sides by relatively barren regions.

It does not inevitably follow from this, but manifestly must be regarded as highly probable, that in such richly crowded regions of space stars of many different orders of real size are gathered together. The stars seen within these rounded parts of the heavens are of many different orders of *apparent* size, but the brighter ones *may* be much nearer to us than the rounded cluster, and merely seen as it were by accident in the same field of view. But while of course this is possible, it is highly improbable, and in fact when attention is directed to the numerical arrangement of

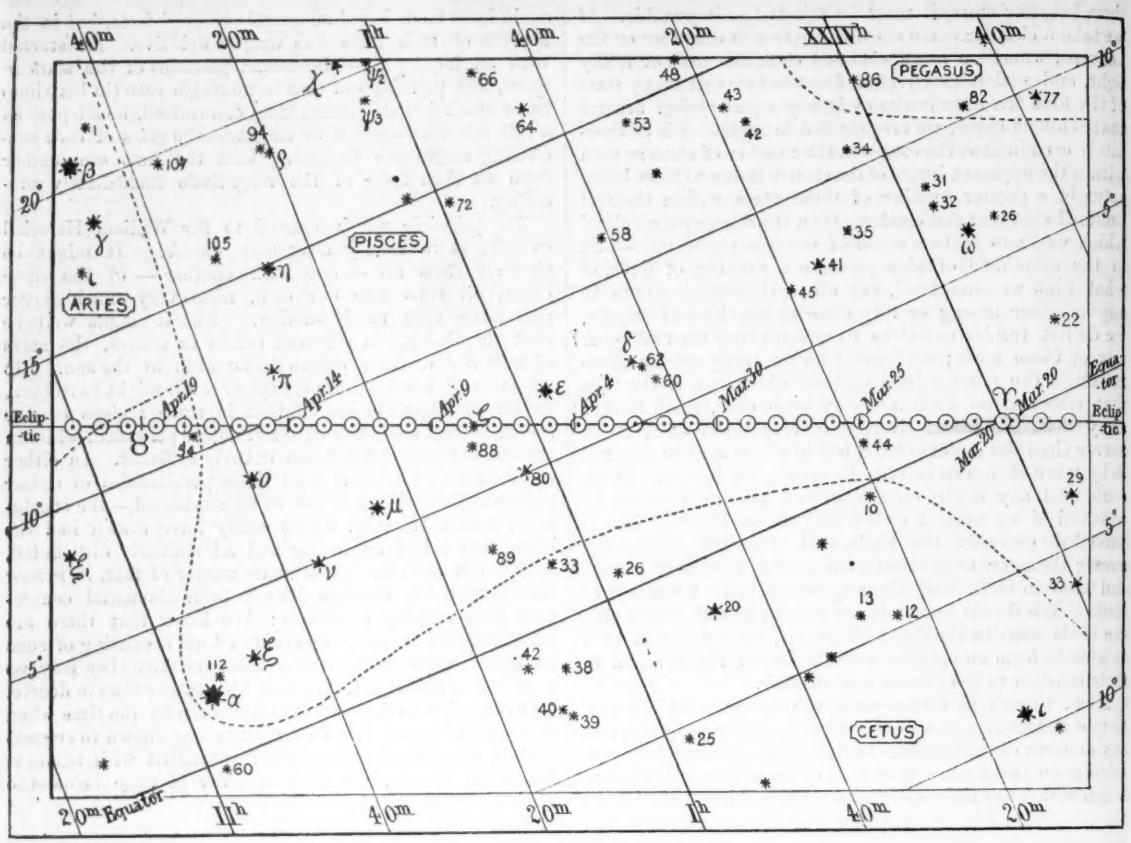
these brighter stars, it must be rejected as impossible. If we take a circular space say four degrees in diameter on the heavens, where we see a rounded cloudlike mass of milky light, and within this region find ten times as many stars of the first ten magnitudes as in any equal region around that rounded space, we are justified in regarding it as absolutely certain that the excess in the number of stars so seen within the apparent limits of the cluster is due to there being actually a greater number of those stars within the real limits of that rounded cluster. If on the skies we see a cloud which we know to be a cloud of insects—say locusts—and in the same field of view perceive a number of birds, of what kind we cannot tell, but all of them so situate as to appear either among or very close to the cloud of insects, we do not trouble ourselves to reason about the real situation of those birds; we *know* they are really among those insects. The mind rejects without discussing it the idea that either those birds are very large ones, much farther away than the insect cluster, or very small ones, much nearer than the insect cluster, but in either case so situated as by mere chance to seem to be among the insects. If we could feel any doubt on the subject all doubt would be removed if we noticed either that as the flight of insects travelled onwards the birds still remained apparently among them, or that there were several clouds of insects and that in each cloud there appeared to be a number of birds. We should be absolutely certain in either case that the birds were in the flight of insects, and we should thus be able to form an opinion as to the size of the birds, as to their relation to the insects, and so forth.

Now, though this may seem a very commonplace and simple illustration, such evidence is in reality as decisive as any amount of mathematical calculation, and especially any calculation based (as a great deal of the mathematical calculation which has most impressed mankind *has* been based) on mere opinion as to what may be. To an observer who had noticed the constant association of birds and insects just considered, and had thus been led to infer that they were small birds pursuing the insects for their food, no amount of learned talk about the ways and habits of some order of large birds, no amount of calculation as to the chance that such birds travelling in flights might seem to be immersed in the insect clouds, though not really so, would have or ought to have the least particle of effect. He would answer, and justly—I know that such and such small birds pursue and eat those insects, I see birds of the right apparent size among the insects, and though I cannot be sure that they are those very birds whose insect habits I know of, I am sure they are birds of about the same size and of the same ways, for there they are at their work: the chance may for aught I know be as the coefficient of $x^p y^q z^r$ in the expansion of $(x+y+z)^n$ to the sum of all the coefficients in that expansion that those birds are wild ducks or geese or storks, really flying far above the insect clouds, and you may be quite right in your determination of the value of that chance; but your determination has no value whatever for me: your ducks and geese and storks are purely hypothetical, as are the habits you choose to assign to them to account for their forming into such groups as you suggest. But the birds I see are real and so are the insect clouds. The connection between the two sets of groups is certainly not accidental, and my explanation, which agrees with all the known facts, suffices for me, as it would for any one who bases his opinions on observed facts and reasoning thereon.

Sir W. Herschel, in the fine papers of 1811 and 1814, followed the simpler and more truly scientific way of dealing with his observations. In 1817 and 1818 he followed a plan which would have been most effective if it could have been based on actual observed facts, but in the absence of such facts was simply delusive. He started with an inquiry into the actual positions of the stars in space, and pointing out that in no single case (in his time) had a star's actual distance been determined, he adopted as a safe rule that—one with another—the stars of each succeeding magnitude beginning with the first are further from us than those of the magnitude immediately preceding.

The principle which seemed to Sir William Herschel so safe, is in reality altogether unsafe. It might be that all stars are — one with another — of the same order, all suns like our own, none very much larger and none very much smaller. But it might well be that they belong to different orders or classes, the stars of only *one* of these orders being akin to the sun. It might be (I am speaking always of what might have been, so far as Herschel knew) that in some regions of the stellar system one order of distribution prevailed, while in another the arrangement was entirely different. In either case,—and still more if both these peculiarities of stellar nature and distribution had to be considered,—the conclusions which Herschel might safely have drawn had the stars been all of one order and all similarly distributed, would not be true. As a mere matter of fact, it is now known that Sir William Herschel's fundamental conception was entirely erroneous: We know that there are several orders of suns, one order at least consisting of suns so much larger and mightier than he that they may be regarded as differing from him in kind rather than in degree. But the point to be noticed is that even at the time when Herschel advanced this view enough was known to suggest that it was incorrect, because inconsistent with analogy. The solar system, the next in order of scale below the system of stars, was known even then to consist of different orders of bodies, arranged in families. There was first the central ruling orb; then there were the giant planets Jupiter, Saturn, and Uranus, each with its family of dependent worlds. Then there were the four known asteroids, all travelling at nearly the same distance from the sun; and lastly there were the four terrestrial planets, Mercury, Venus, the Earth and Mars, as distinct in character from the asteroids on the one hand as from the giant planets on the other. In our day we know more respecting these chief divisions of the solar family, but our knowledge is of the same kind as Herschel's. To suppose in the face of such knowledge as he possessed that the next system in order of scale possesses no such variety of construction, but, on the contrary, is monotonously uniform, was not (as Sir W. Herschel seems in the closing part of his career as an inquirer to have imagined) to show extreme caution, but recklessly to run counter to all the available evidence. It may be said that now we *know* he was mistaken it is easy to point out why he ought to have thought differently; but as a matter of fact the evidence was clear and convincing; it had been noted ere as yet he had reached extreme old age by himself, and he had himself collected evidence which had forced him to recognise that the stars in one region of the stellar universe are very differently arranged from those in our neighbourhood.

Having overlooked in these later papers the circumstance that stars of certain orders are collected in certain regions of the stellar system must give very misleading evidence if they are regarded as of the same class and arranged in the same way as the stars forming our constellations, Sir W. Herschel was naturally led to erroneous conclusions in his new lines of inquiry. Any one who should start in his inquiry into our solar system, with no other evidence but the apparent positions and sizes of the planets of all orders,



The Day Sign for the Month.

would form an utterly erroneous idea as to the arrangement of these bodies. He would suppose Jupiter, Mars, Saturn, and Venus to be near, the asteriods to be far away, the whole system to be a flat disc in the midst of which our earth was set as one of a number of nearly equal and uniformly distributed bodies. He would be entirely mistaken, but not more mistaken than was Sir Wm. Herschel in the conclusion to which he was led in 1817 by a process of reasoning antecedently likely—one may say certain—to lead to an erroneous result.

Let us see what that reasoning was, and what was the result to which it led.

(To be continued).

THE THIRST CURE FOR CORPULENCE.

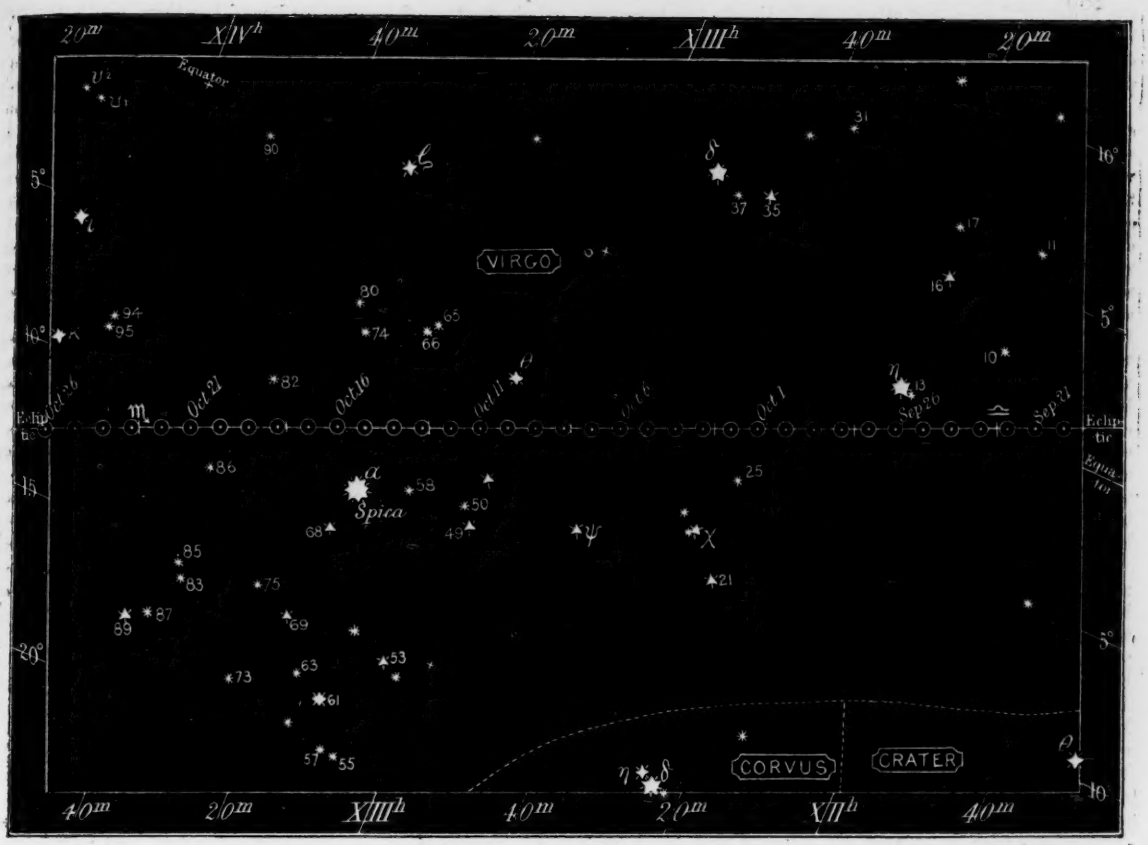
By Richard A. Proctor.

A CORRESPONDENT of the *Standard* has dwelt on the effectiveness of thirst in curing, or rather in preventing, corpulence. By taking but three half-pints of liquid daily he found his weight reduced a pound a week, and without any special restriction upon the amount of solid food. Moreover he found that he soon became accustomed to the reduction in the quantity of liquid food. A physician a few days later confirmed the experience of the former correspondent.

There can be no doubt that the method indicated is a sure and rapid cure for corpulence. But it is one which ought not to be adopted without medical sanction by persons of gouty diathesis, or probably by those having any constitutional tendency to excess either of acid or alkaline secretion. As to the gouty or lithic tendency I speak from experience. In the spring of 1868 I followed most successfully the thirst cure for corpulence. I was not, indeed, very corpulent at starting, though my weight —13 st. 4 lb.—was greatly in excess of that fairly due to my height (or shortness) and breadth. In the course of two months I reduced my weight to 11 st. 3 lb. But a constitutional tendency to a form of gouty trouble showed before that time most unpleasant readiness to increase and multiply tortures whereunto I strongly objected. Unfortunately, I did not for awhile recognise the connection between this result and the system by which I was so successfully reducing my weight. When I did, and resumed a more generous liquid treatment, I soon got rid of my lithic troubles.

In 1874, speaking with Dr. J. W. Draper on the subject of similar troubles experienced by him to a much greater degree, I mentioned my experience, showing what a valuable medicine water is. Although physicians are apt to regard lay suggestions with indifference, he noted my experience,—and when I met him in 1876 he told me he had enjoyed two years of freedom from the sufferings which had formerly been so severe.

It may be that by the use of appropriate medicine the thirst cure for corpulence may be made as safe as it is sure. For instance, a person of gouty tendency might take a



Night Sign for the Month.

certain small quantity daily of the bicarbonate of potass (or the bicarbonate of soda) in his pint and a half of water or whatever other beverage he took. But I venture to warn the obese not rashly to adopt the thirst remedy, lest haply, in their unwillingness to "bear those ills they have," they

"—— fly to others that they know not of."

ZODIACAL MAPS.

By Richard A. Proctor.

WE give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

ICHNEUMON FLIES.

By E. A. Butler.

(*Continued from p.* 245.)

ICHNEUMONS do not confine their attacks to the Lepidoptera; some are parasitic upon beetles, some upon plant-lice, some upon flies, and some even upon other hymenopterous insects; they also extend the range of their enmities beyond the pale of the insect world, and, in some cases, live at the expense of spiders, whose eggs their grubs devour; still, the Lepidoptera are the group they principally affect. It must not be supposed that they are indiscriminate in their attacks; they will not take up with any caterpillar they come across, and very frequently each species of caterpillar has its own peculiar foe or foes, ever on the look out for it and ready to pounce upon it without a moment's warning. The elucidation of the life history of these creatures is not an easy task; the collectors of the Lepidoptera, in their efforts to rear their favourite insects from larvadom, are often baffled by the ichneumons, and in their disgust at getting a crop of uninteresting-looking "flies" instead of the handsome moths they had set their hearts upon, too often cast away the parasite as a despicable, worthless thing, and so lose the chance of solving a problem in nature. The determination of the species, moreover, is often an exceedingly difficult matter, so that it needs the combined efforts of a good Lepidopterist and a good Ichneumonologist before the matter can be settled—the former to determine what the caterpillar is, for, be it remembered, there is no chance of seeing the perfect moth, and the latter to decide on the ichneumon. Thus it happens that the hosts of many are still unknown.

Though so intensely carnivorous during their larval existence, these insects do not appear to have similar tastes in the adult state. They have, it is true, a good pair of jaws, but these they seem to have no great anxiety to use. If seized between finger and thumb, they do not attempt to bite, but wriggle their abdomen about in attempts, which are more often than not abortive, to wound with their ovipositor. Such food as they take seems to be confined to

the honey of flowers and other equally simple and harmless kinds of diet; hence many species are attracted to flowers, and the broad heads of the Umbelliferæ often form a pleasant foraging-ground for considerable numbers.

Many ichneumons are very active in their movements, and some, when running about over the leaves of plants in search of caterpillars, have a peculiar habit of rapidly vibrating their antennæ, as if trembling with excitement at the urgency of their business. Those with short ovipositors seek caterpillars that feed in exposed positions, where they can easily be reached, and such may, therefore, be found running over plants, &c.; but those with long ovipositors may be looked for on walls and trunks of trees, where they are on the look-out for caterpillars that shun publicity and lurk in obscure corners and in crevices of brickwork, or that burrow into the solid wood of the tree-trunks; hence the length of the ovipositor, which can be thrust down into burrows far too narrow for the ichneumons themselves to enter. In this way they can feel about till they find the object of their search, whose body is forthwith pierced and an egg inserted. Of course, those with long ovipositors, when intent only on their own delectation, and not engaged in oviposition, may be found on flowers with the other kinds.

There is often great disparity between the sexes; the males are sometimes so utterly unlike their partners as to have been referred not only to different species, but even to different genera. Thus one series have narrow-bodied, yellow-banded, long-winged, long-legged males and broader-bodied, red-banded, shorter winged, shorter-legged females. In some again, the males are winged, and the females absolutely apterous (Fig. 3), thus presenting a superficial resemblance to ants, from which, however, they may at once be distinguished by the fact of their antennæ not being elbowed, as those of ants are. White, yellow, and various shades of red, through deep browns to black, are almost the only colours with which they are adorned, and black, as a rule, forms a more or less important element in the coloration. The yellow is usually distributed in the form of bands on a black body, thus giving these slender creatures a supposed, but certainly very remote, resemblance to the heavy-bodied wasps. It is astonishing how frequently this style of ornamentation is met with among insects; besides the ichneumons, it occurs in bees, wasps, sawflies, flies, beetles, moths, and dragon-flies; but it is specially common amongst some sections of the Hymenoptera.

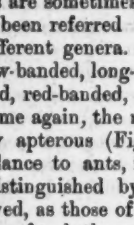


Fig. 3.—Pezomachus transfuga. Female.

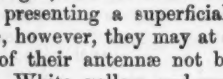


Fig. 4.—Forewing of Zele testaceator.

Some of the cocoons of ichneumons are marvels of elegance and neatness. They are of various hues—white, yellow, brown, black, and sometimes they are banded with different colours. They are almost always of an elongate oval shape. Sometimes the silk of which they are composed is so closely spun up together that the outside is almost as smooth as the inside, which is saying a great deal, and the whole has a paper-like consistency, the white ones having a lustre like satin; but, on the other hand, the outside sometimes has a certain amount of loose silk hanging about it like that of the silkworm, and occasionally whole clusters of cocoons are bound together in a common mass of silk. Some of these objects are probably familiar to most people, as groups of them are often found on walls towards the end of summer, enveloping the shrivelled carcasses of the caterpillars of the common white butterflies that work such havoc among cabbages.

There are two large families of Hymenoptera to which the name Ichneumon Fly is usually applied, though these do not by any means include the whole of the insects that have similar parasitic habits. These families are the Ichneumonidæ and the Braconidæ. They may be easily distinguished from one another—at least, those that are not apterous—by the neuration of the wings, which very constantly follows, with only slight variations, a distinct plan in each group. Fig. 4 represents the wing of a Braconid, and may be compared with the wing of an Ichneumonid shown at Fig. 1 in the former part of this paper. The species are unequally divided between these families, the Ichneumonidæ being by far the more numerous of the two. Many of the Braconidæ are very small, and it is to this family that the insect belongs which makes the clusters of tiny oval cocoons referred to above as forming a shroud for the mangled remains of the caterpillars of the cabbage butterflies. In escaping from their cocoons, these little creatures detach a small piece at one end which looks like a kind of lid, and generally remains hanging by some silk threads belonging to the outer surface.

TRICYCLES IN 1884.

By John Browning,

Chairman of the London Tricycle Club.

TRYING THE TANDEM.

IT is necessary at the outset for me to say that I have purposely written trying *the* Tandem, and not trying *a* Tandem, or otherwise I should find myself accused within a week of not knowing that a Tandem had been invented previous to this particular machine. If this should seem ridiculous, I would ask attention to a paragraph of mine in another part of this number.

At the recent great Exhibition of Tricycles, at the Agricultural Hall, Mr. Cooper, of the renowned firm of Humber, Marriott, & Cooper, invited me to take a ride with him on the new "Humber Tandem," for the purpose of testing the machine.

I started with him at one o'clock in the day to ride forty miles. Rain had been falling heavily early in the morning, and the roads for the first few miles were covered with mud, and were heavy for several miles out.

The new Tandem is simply a "Humber" Tricycle, with a seat in front for a second rider to drive by means of central gearing—a pair of bicycle pedals. The tube which carries these pedals projects forwards, and carries a small safety-wheel, about 6 in. in diameter, under a pair of foot-rests. The safety-wheel is provided with a strong spiral spring, to break the shock if it touches the ground suddenly, and is arranged as a castor, so that if it touches when the machine is turning it instantly follows the line of the machine. I may at once state, however, that it never, throughout the day, touched the ground but once, and that was only on crossing a raised footpath across a very rough macadamised road, where the machine had to dip down and rise again; it touched here and spun round, but it rose again instantly, and did not in any way influence the action of the machine, or communicate any shock to me. Indeed, I should not have known it had touched the ground had I not seen it turning.

Throughout the ride I experienced none of the difficulty in keeping up a conversation with my fellow rider which I had anticipated in riding a tandem.

When passing over some villanous rough granite, running at a very rapid pace down hill, I said that my hat was getting loose. Thereupon Mr. Cooper bonneted me most effectually with a cheerful alacrity which gave me a high opinion of his presence of mind in any emergency.

As soon as we got well off from the rough granite of the metropolis, we ran easily, when unimpeded by traffic, at the rate of about ten miles an hour. As the machine was geared up to 54, the pedalling at this pace was not at all rapid, and unless the distance and time had been taken carefully, I should not have thought it possible that we were travelling so quickly.

From Brompton we ran to Kingston without stopping a pedal.

Just as we were getting nearly to the bottom of one of the hills after leaving Kingston, we saw two ladies walking down the middle of the road. Neither ringing a bell, whistling, nor shouting had any effect in attracting their attention to the fact that we were close upon them. When suddenly Mr. Cooper gave a cry close behind my ear to which the cry of a screech-owl would be music. Until I heard this cry I thought sounding the Otto horn the best possible method of waking people up who were inclined to go to sleep in the middle of the road, but it is not to be named in the same week with the sound of the human voice when properly pitched (?), as in the Cooper-screech. I cannot do more than attempt to describe this, but must content myself by saying that it combines the effect of a girl's shriek when she has discovered that her clothes are on fire and a dog's agonised yelp when his hind leg has been run over. I have actually seen it effective in waking a drunken carter, and should think it might wake the dead unless they were in double coffins.

At Kingston we noticed a racing bicycle outside a house. Having stopped and partaken of some sandwiches here, we proceeded on our way, improving the pace as we went on, and settling down to work together, but not attempting to force it. About three miles before we reached Ripley, we were overhauled by the owner of the racing bicycle we had left at Kingston. We had no idea he was near us until we saw him pass, for he travelled quite noiselessly. As he went by us we increased our pace, and as he had evidently, although a first-class rider, overdone himself in catching us, and was riding a machine too high for him, in trying to keep in front of us, he missed his pedal and came down heavily. He cut his hands rather severely, and damaged his face, though not seriously. We, of course, stopped and helped him up, waited till he had recovered himself, and then proceeded with him at a more leisurely pace on to Ripley.

All the way we had been riding against a tolerably strong south wind. After partaking of tea at Ripley, where our bicycling friend had his injuries attended to by a chemist, we returned to town, the bicyclist accompanying us. Two long rests, the attention he had had, a good tea, and half-an-hour's riding had refreshed him so much that, like a plucky Englishman, he challenged us to try our pace with him; but, both Mr. Cooper and myself, without consulting on the subject, made the same answer, that we did not come out to race, but only to test the machine and to try what pace it would go with easy riding.

The wind, which had been strongly against us while riding out, had fallen with the sun considerably, and shifted so as to be across our roads, so that we had little benefit from it in returning.

At Kingston our bicycling friend left us. Curious to relate, his machine, which only weighed 26 lb., and had a 53-in. wheel, did not receive the slightest injury in the fall.

In returning, we were catching up to a horse in a light cart. The sun was nearly setting behind us, casting long shadows on the road. Suddenly the horse reared, and then made as if he would bolt. "What are you about, you stupid brute?" said the driver; "there's nothing to shy at except your own shadow. God knows that's ugly enough; but *you* ought to have got used to it."

At Wimbledon Common we met two gentlemen who had just brought down one of the new Humber Tandems, and had not yet taken it to their home, and they expressed their great satisfaction with its easy running.

Time was taken carefully from place to place, and when we reached Humber's premises we found that we had ridden 40 miles in a trifle under $3\frac{3}{4}$ hours, by which it will be seen that we averaged nearly 11 miles per hour.

I was as cool when I got back as when I started. I had never been warm once throughout the day, let alone hot; and Mr. Cooper assured me he had never had so easy a ride to Ripley in his life. I never at any time did anything like as much work as I was capable of doing, except in riding up the steepest hills, for as soon as I attempted to work hard Mr. Cooper informed me it was unnecessary. I certainly did not ride anything like my best for more than five miles out of the forty.

The steering of the machine was marvellous. Mr. Cooper could evidently control it when going at a speed of 20 miles an hour down hills, so as to steer with perfect certainty within an inch; and while running at this great speed he let go both steering-handles, and placed both his hands on my shoulders, and kept them there for some little time, proving the tendency of the machine to run in a straight line without steering.

Several times I have run the risk of prophesying, in spite of the witty injuction to the contrary, with regard to the weight of machines, the price of machines, and the size of wheels, but I candidly admit that the last thing I should have prophesied would be that the "Humber" tricycle would make the best Tandem tricycle yet known, and I started with some prejudice against it. After my experience, however, I must say that I consider it, in good hands and with judicious management, the fastest, safest, and easiest machine yet made, combining, as it does, the comfort of a tricycle and the speed of a bicycle.

Under the skilful pilotage of Mr. Cooper the machine ran with less vibration than any other tricycle I have ridden considering the great pace we made. As we rode up the hills at the rate only of six or seven miles an hour at the utmost we must, over the best parts of the road where they were clear, have been travelling at something like the rate of fifteen miles an hour to have covered the whole distance in the time we did.

I did not enjoy this ride more but less for proceeding at such a high pace, though it was accomplished so easily. The day was exceedingly fine, and the views across Putney Heath and Wimbledon Common, the run by the riverside after passing through Kingston, and the lovely country from Esher past Claremont Park, and across Esher Common and Wisley Common made me long again and again to linger in passing through such exquisitely pretty scenery.

I place but little value upon the great speed of a machine as a question of speed, but it cannot be too clearly understood *that a machine which can be ridden at a great speed with but little exertion will go at a moderate pace with scarcely any exertion at all.*

The "Humber Tandem," can be confidently recommended to husbands who wish to take their better halves out

tricycling, yet desire to keep them in a proper state of subjection. As the lady cannot sit astride the backbone, she must take the front seat with her back to the gentleman, who has the sole control of the break and steering; and let him say what he will, she cannot, while the machine is travelling, resent it, for she cannot turn round on her seat with safety, and she is not likely to let go of either of the handles, and if she should in any way contrive to make herself unpleasant her partner has only to put his break on suddenly, without giving her any warning, and she would find herself landed on the ground in the twinkling of an eye, whether safely or not might be uncertain, and this uncertainty would doubtless induce her to avoid such a "little difficulty" again.

Two days after I had taken this ride Major Knox Holmes rode 101 miles with Mr. Cooper on the "Humber Tandem," in 12½ hours, including stoppages of 1 hour 45 minutes; riding time, 10 hours 45 minutes.

Starting from Croydon they rode to Brighton and back to Croydon, and then returned to Merstham, and went back to Croydon. Major Holmes, who is 78 years of age, was fresh and well at the finish. A wonderful machine and a still more wonderful man had come together.

THE EVOLUTION OF FLOWERS.

By Grant Allen.

VI.—TULIP AND FRITILLARY.

THE simpler and earlier lilies, well represented by our English Gagea, have bunches of small flowers at the end of a tall stem; and familiar examples of this type are afforded us by the Star of Bethlehem and the common wild garlic. But the more advanced lilies, especially in northern climates, often bear a single larger flower only, the increased attractiveness of the big petals making up, apparently, for the diminution in the blossoms, according to the usual principle that every gain in effectiveness is accompanied by a corresponding loss in number. Of these higher lilies we may take as typical specimens the garden tulip, and the fritillary.

So far as regards structure, the tulip does not differ essentially from the little yellow Gagea. Its points of variation are all adaptive in the simplest degree, and have reference almost entirely to its increased attractions for the larger insects. The tulips, however, are altogether finer, heartier, and more successful plants than the little Gagea, and have consequently throughout a decidedly bolder and more succulent growth. They inhabit naturally richer soils, where they can spread themselves more freely to the sun and air. Hence their leaves are not usually narrow and grass-like, as is the case with Gagea, but broad and thick, or sometimes almost fleshy. Their bulbs, stems, and blossoms are also larger, and their appearance more generally prosperous. But the great distinction which marks them off from Gagea and its allies is the fact that their petals and sepals, instead of spreading out horizontally, so as to form a flat open flower, converge together into a bell, thus producing a sort of cup or goblet for the fertilising bees. Still, the sepals and petals remain distinct from one another, and do not actually unite into a single solid bell or tubular corolla, as in the garden hyacinth: that last advance in integration is one which we shall only meet on a somewhat higher level. In our garden tulips (varieties of *Tulipa gesneriana*), and in most other species, the flower stands upright on the top of the stalk, instead of turning downward, after the common fashion of tubular blossoms. This is a trick which it shares with a whole host of similar large handsome flowers, like the crocuses and colchicums: and everybody who has ever watched a bee at work among them, bustling about at the bottom of the deep enclosing well, must have observed how very effectually it conduces to the proper fertilisation of the stigma. Garden tulips have only one flower on each plant, but some few other species have occasionally two, a last relic of the large bunch produced by their lower relatives.

We have on a few Welsh mountain-tops some little colonies of a very interesting intermediate form—*Lloydia serotina*—which combines some features of the true tulips with some features of the simpler type represented by Gagea. This pretty little plant, a mountain and arctic lily widely spread over Europe, Asia, and America, is a tulip in all its technical characters, but bears a single small white flower with spreading and open petals, like those of wild garlic. It is, in short, a simple lily of the Gagea type, verging in the direction of a tulip, but still preserved for

Tulipa gesneriana (Garden Tulip).

us under its comparatively primitive shape in the extreme north or on the chilly mountain-tops; while its relatives in more favoured climates have developed under happier conditions, and by stress of more advanced insect selection, into the large and handsome Asiatic tulips.

Even more characteristic, in some ways, of the higher lily type, is the common English fritillary or snake's head (*Fritillaria meleagris*), which grows abundantly in swampy meadows about Oxford, and in many other parts in the southern and eastern counties. The fritillaries are a group of handsome bell-shaped blossoms, with their sepals and petals still quite distinct, but with a very large and well-marked nectary near the base of each, thus testifying at once to their attractiveness for the honey-sucking insects. Unlike the tulips, their flowers droop downward, so that the bee has to approach them from the under-side. Our English species has only one blossom to each stem, but some South European kinds have two, and the crown-imperial of our gardens has a whole cluster of them, thus rendering it exceptionally conspicuous and brilliant. The colour of these

flowers gives us an excellent lesson in the principles of floral colouration. Unlike the Gagea, which is primitive yellow, and the Lloydia, which is white with a yellow spot at the base (a great many other flowers have this same

Lloydia serotina.

intermediate arrangement) the English snake's-head is usually a dull lurid red, curiously marked inside with very remarkable chequered spots. Now, there is reason

Fritillaria meleagris.

to believe that the general progress of colouration in flowers runs from yellow, through white and pink, to red, purple, and finally blue. The snake's-head has thus got about half-way up the ladder; but, as often happens, every now and then it begins to tumble down again part of the distance, or even the whole of it. White fritillaries are intermixed with red ones in the Oxford meadows, and here and there one may even come across a yellow specimen. At the same time, it is interesting to note that in some species of fritillaries this relapse in colouration, which occurs only occasionally in our English snake's-head, has become normal or habitual, no doubt owing to some change in the particular insect visitor by whose aid they are usually fertilised. It is well known that different kinds of insects have very different tastes in the matter of colour, and they select accordingly those variations which best suit their own peculiar æsthetic ideas. But what is most important of all is the curious fact that most yellow fritillaries show unmistakable signs of having been descended from red chequered ancestors, just like our own snake's-head, for though yellow is their prevailing colour, they are loosely sprinkled over with reddish-brown marks, exactly similar to those of the English species. Moreover, in all cases that I have observed (for example, in the yellow *Fritillaria delphinensis* of the Riviera, and the *F. lutea* of the Caucasus) the nectaries and base of the petals are still red, as are also the edges in many instances. This clearly points back to an original red ancestor, and shows that the yellowness of the flowers is not like the primitive yellow of Gagea or of the buttercups, but an incomplete reversion from a higher stage. By far the greater number of fritillaries are purplish red, and the yellow ones always bear marks of having fallen from their high estate. Our own snake's-head is chiefly fertilised by bees, both hive-bees and bumble-bees, as well as by a few other insects. Its secretion of honey is exceptionally abundant.

It is curious to observe in this same connection that a wild yellow tulip (*Tulipa sylvestris*), not, perhaps, truly indigenous to Britain, has established itself in some of the eastern counties. The group, as a whole, is a southern one, and its prevailing colours are scarlet and pink, often with a dark purple or almost black base to the petals; but in this more northern European species there is the same sort of reversion to yellow as in the Caucasian fritillaries. As a rule, the yellow of such reverted flowers is paler and less golden than in the more primitive buttercup and potentilla types.

Royal Victoria Coffee Hall (Waterloo-road, S.E.).—On Tuesday, April 1, a lecture was given at the above hall, by E. B. Knobel, Esq., Sec. R.A.S., on "The Planets," to a large audience of working people. The lecturer divided the planets into groups, according to their physical characteristics. First, Mercury and Venus, where the absence of surface-markings prevents our knowing anything as to the length of their day or the successions of their seasons. Secondly, the Earth and Mars, which have nearly the same length of day and succession of seasons; while the likeness between them is increased by the presence of watery vapours, and probably of an ice-cap at the poles. Thirdly, Jupiter and Saturn, with their many satellites, and their ever-varying markings, which probably show that these planets are gaseous. Lastly, Uranus and Neptune, of which we know comparatively little, but which possess an interest all their own from the way in which the latter planet was discovered. The lecturer told, in some detail, how perturbations in the movements of Uranus led to the discovery of Neptune. It is gratifying to notice how the audiences increase as these lectures become better known.——During the next few weeks the following Penny Lectures will be delivered, on Tuesday evenings, at the Royal Victoria Coffee Hall, Waterloo-road:—April 22, Rev. P. H. Wicksteed, "Camping-out on the Thames." April 29, Sir Thomas Brassey, M.P., "A Visit in the *Sunbeam* to the West Indies." May 6, Dr. W. B. Carpenter, "Ice, and its Work in Earth-shaping." May 13, Mr. Vernon Boys, "Fire, Electricity, and Other Forms of Power." May 20, Prof. H. G. Seeley, "A Working Man's Dinner." May 27, Mr. J. Norman Lockyer, "The Recent Eruption of Krakatoa."

Reviews.

SOME BOOKS ON OUR TABLE.

Workshop Appliances. By C. P. B. Shelley. Sixth edition, revised and enlarged. (London: Longmans, Green, & Co. 1883.)—As an example of a handbook, indispensable alike to the professional and amateur mechanic, this work of Professor Shelley's leaves nothing whatever to be desired. Reading through its descriptions of tools, at once plain, perspicuous, and exhaustive, we find it hard to conceive that the implements of the handicraftsman could be rendered more intelligible, or their use more clearly explained, than they are in the work before us. The mechanical engineer, the turner, the fitter, the carpenter, and the joiner will each find here an illustrated account of every single tool he employs; both the theory of its construction and the mode of its use being made thoroughly clear. There is an excellent account, with numerous engravings, of Sir Joseph Whitworth's marvellous apparatus for measuring to the one-millionth part of an inch; while the 291 woodcuts which illustrate the book comprise at once objects as diverse as a bradawl and a planing-machine; a screw-cutting power lathe and a spoke-shave. We have no difficulty in understanding why Mr. Shelley's work has reached a sixth edition. We are quite prepared to hear of its attaining a sixteenth.

Notes of Lessons on Moral Subjects. By F. W. Hackwood. (London: T. Nelson & Sons. 1883.)—In the year 1878 the Education Department issued a circular to her Majesty's Inspectors of Schools, insisting on the importance of affording moral training to children in elementary schools over and above the intellectual teaching which it is the primary object of such schools to furnish. It is to facilitate such instruction that Mr. Hackwood's book has been compiled. It consists of a series of lessons on such subjects as Honesty, Truthfulness, Candour, Honour, Benevolence, Courage, Integrity, and the like; partly consisting of question and answer, but mainly of oral exposition by the teacher, illustrated by anecdotes, poetry, &c. The chief fault that we find with this work is that it is much too highly pitched and "fine" for the class for which it is ostensibly intended. Sharp children who have passed the upper standards in large towns and cities may appreciate the sonorous periods and rounded sentences in which instruction is to be conveyed, but we tremble to think of its effect upon a schoolroom full of boys and girls in a purely agricultural district. As furnishing hints to the teacher, though, undoubtedly Mr. Hackwood's volume has its value.

Unclaimed Money. A handy book for Heirs at Law, Next of Kin, &c. By E. Preston. Seventh Thousand. (London: E. W. Allen.) Here is a book that might well furnish forth fifty of the three volume novels which give intellectual indigestion to Mr. Mudie's subscribers. Apart from the curious stories with which it is filled, however, it really does contain a considerable amount of information, valuable to those who are at a loss how to proceed for the recovery of money to which they are—or fancy themselves to be—entitled. We had no idea until we perused Mr. Preston's readable little book that there was so much unclaimed money (to use an expressive vulgarism) "kicking about" as there undoubtedly appears to be.

Vignettes from Invisible Life. By John Badcock, F.R.M.S. (London: Cassell & Company. 1883.)—Apparently modelled to a considerable extent upon the delightful "Marvels of Pond Life," by our own esteemed contributor, Mr. H. J. Slack, Mr. Badcock's book should form an instructive and acceptable present to the young microscopist; describing, as it does, prettily and popularly, the leading forms of Protozoa, with the Rotifera, Volvoces, Water-bears, Hydra, Sponges, and Diatomaceæ. The wood-cuts are, as a rule, really likenesses, and the beginner with the microscope may do worse than obtain "Vignettes from Invisible Life."

Manual of Taxidermy. By C. J. Maynard. (London: Trübner & Co. 1883.)—Everyone who has travelled abroad, to say nothing of those who have come across rare specimens of animated life at home, must have felt the desirability of possessing some knowledge of taxidermy, and of being able to preserve a bird, beast, fish, or reptile in a condition which should enable it to be subsequently studied with advantage. Many a superb beast-skin, many a beautiful bird, has been reduced to a species of scrubby rug, or an amorphous mass of feathers, for the want of some rudimentary acquaintance with the art of preserving it, on the part of its captor. We well remember our own maiden effort in this art, which took the form of an attempt to stuff a tern, with the result of the production of a species of feather sausage! Had we only had Mr. Maynard's capital little book at hand, we might at least have been spared so ignominious a failure as this. Beginning with birds, he teaches us how to trap, shoot, or procure them in other ways; how to skin them, stuff them, and mount them; and how to construct the stands on which they are placed. This section of the book is followed by one giving equally detailed instructions with regard to mammals; and it concludes with a chapter on mounting reptiles, batrachians, and fishes. It is a work which should be in the library of every practical naturalist.

Capital for Working Boys. By J. E. M'Conaughy. (London: Hodder & Stoughton, 1884.)—This is apparently an English republication of an American book, every local reference in it being drawn from persons and places in the United States. Its aim is a laudable one; but the hand of Mr. Chadband, or one of his congeners, is too apparent throughout, the "I say untoe you my brethren" element being painfully conspicuous. This is regrettable, in so far that the book does contain a good deal calculated to strengthen and encourage lads who have to make their way, unaided, in the world, but who may well be repelled by the hyper-sanctimonious tone in which they are here addressed. We protest altogether against the dicta of the author regarding the theatre on pp. 56 *et seq.* It contains just that extremely small modicum of truth which gives the most dangerous form to a lie. There is, at the very least, as much evil and harm to be got in many a chapel as there is in an indifferently-conducted theatre; while it is much to be desired that as sound moral training (to say nothing of purely intellectual gratification) were derivable from a majority of our pulpits as may be obtained in a high-class one. So, again, with reference to the question of Sunday (or as Mr. M'Conaughy calls it, "the Sabbath"), treated in our author's XXIInd Chapter. What may be the case in the United States we cannot presume to affirm; but that opening museums and picture-galleries in England on that day would lead to the gradual introduction of Sunday labour, it is simply childish to assert. The trade unions alone will take exceedingly good care that that does not happen. Possibly, too, our author would fail to see how unwittingly he is playing into the hands of Messrs. Aveling, Bradlaugh, Foote, and Ramsey by his XXVth Chapter. And we should like to have the candid opinion of our own contributor, "Five of Clubs," as to the denunciation of cards which appears on pp. 98, &c. *Malgré* the faults at which we have hinted, this would not make a bad Sunday-school prize.

Editorial Gossip.

In the *Evening Journal* of Adelaide, for March 8, 1884, a writer takes me to task for what he regards as an error in my solution of the problem of the flight of a projectile, Vol. 4, pp. 10, 11. I there assert that the projectile throughout its flight describes equal areas around the earth's centre. He denies this, saying that the velocity remains unchanged while the distance from the centre increases, therefore the areas described must increase too. He seems to suppose that it was a mere fad of mine to apply Kepler's second law to a projectile. But in reality the law observed by Kepler to hold in the case of a planet is part of a more general law, established by Newton, in the *Principia*, book I., sect. II., prop. I., in which he establishes the theorem that *The areas which revolving bodies describe by radii drawn to an immovable centre of force do lie in the same immovable planes, and are proportional to the times in which they are described.* The mistake made by my critic lies in overlooking the change in the angle at which the projectile's path is inclined to the moving line from the earth's centre to the projectile. It would not be easy properly to follow out the changes of inclination: by using the general law I avoided the difficulty.

I may presently take up the discussion of the more general problem of the flight of a missile projected in any direction with any velocity and from a point in any latitude. But I shall only sketch the conditions of the problem, not being likely to have time to follow it out in all its details.

The mistake involved in the reasoning of the Adelaide writer is the same which one meets with in regard to the way in which a sportsman aims at a bird passing athwart the line of fire. It is quite commonly supposed that if such a sportsman so turns that while he is aiming he keeps the barrel constantly directed towards the bird (with due correction for elevation) he will hit the bird when he fires. As a matter of fact the main part of the charge would in that case pass behind the bird, and unless the charge spread sufficiently the bird would be missed.

The four following notes are from an article of mine in the *Newcastle Weekly Chronicle*:—

Mr. William Lant Carpenter, in a lecture recently delivered to a large audience of working men, illustrated his remarks on the mischievous effects of tight-lacing by showing first a series of photographs of Parisian fashions, and then views of the Venus of Milo and Miss Mary Anderson as Galatea. Probably those aware of the tastes of American ladies with regard to figure may be surprised to find that an American should be selected to exemplify the beauty of a natural as compared with an artificially contracted waist. But Miss Anderson appears to be as sensible as she is beautiful; and assuredly she loses nothing by allowing herself the breathing-room which nature gives to women.

We are told repeatedly that there must be something beautiful and attractive in the Parisian waists, seeing that so many women aim at their attainment, while masculine folk apparently admire the fair ones thus distorted. The argument might be used with equal effect in favour of any one of the multitudinous absurdities which fashion has framed. The costumes of a quarter of a century ago were manifestly absurd, and men and women alike look with astonishment at the spoon bonnet, the wide expanse of crinoline, and the other monstrosities of the fashions of 1859-1860. But in those days, while the fashions of half a century ago were similarly ridiculed, women nearly all wore the ridiculous costume which chanced to be in vogue. Nor did men turn from them in disdain on that account, however thoroughly some of them saw the absurdity of the costume. If nine-tenths of the women chose to wear rings through their nostrils, or to adopt the costume of the Andaman Isles, they would find little in the ways of the younger at least among the men-folk to suggest that these were tricks worthy only of savagery.

The argument, in fine, drawn from common consent among women, and apparently general acceptance among men, has no validity whatsoever. It had as much application to crinolines and spoonbills as to tiebacks and panniers; or, in old times, to waists not half a foot from the neck; or, in times still older, to waists three feet long. But breathing is an older fashion, and, we may fairly trust, is likely to prove a longer lasting fashion than these absurdities. And seeing that what is worth doing at all is worth doing well, the fair sex may reasonably learn the lesson that a woman may look her best without depriving herself of half her breathing power as the tight-lacers do, or even of a third of that power, as it has been proved that even those do who lace but lightly.

If the graceful lady who has been one of the chief ornaments of the English stage for some time past should have helped to teach this lesson, it will be a useful addition to the comforting doctrine she has helped to teach, that an actress may charm an audience by sheer force of grace and dignity, and obtain a greater influence by purity and innocence than has been attained even by the cleverest and most beautiful women who have trusted in bold manners and brazen bearing.

At the request of our esteemed contributor, Miss Amelia B. Edwards, we copy the enclosed from the *Academy*:—

To the Compassionate.—Help is implored for a lady who is dangerously ill and absolutely destitute; daughter of a deceased Colonel in the U.S. Army and correspondent of the leading English newspapers.—Subscriptions received by Miss Amelia B. Edwards, The Larches, Westbury-on-Trym, Bristol.

Last week one of my kindly critics (only one would have condescended to make such a statement) informed his readers that I did not know the difference between a central-geared front-steering machine with a double-driving arrangement or balance gear, and a rear-steerer with a hay-fork frame without a double-driving arrangement. In other words, I was accused of praising and censuring the Sparkbrook National in the same paragraph. I need scarcely say that I should not have praised that machine so highly had I not considered it one of the safest machines made. The facts of the case are as follows:—A few weeks since a subscriber to Knowledge asked my opinion of the Sparkbrook National tricycle, adding that an agent had told him it could be ridden up a flight of stairs. I replied "that the central-geared Sparkbrook National was a good machine, but that I should not value a machine any more because it could be driven up a flight of stairs, because it might be useless, or even dangerous for any other purpose." Having set myself right to this extent, if my readers will excuse me for doing so, I will promise them not to pay any regard to such matters for the future, but to treat them with as much respect as they deserve, but no more.—John Browning.

THE FACE OF THE SKY.

From April 25 to May 9.

By F.R.A.S.

THE usual watch should be daily kept upon the sun for spots, &c. Map IV. of "The Stars in their Seasons" gives the present aspect of the night sky. Mercury is an evening star during the whole of the next fortnight, attaining his greatest elongation east of the sun (20° 21′) at 2 o'clock this afternoon. Towards 9 p.m. he may be seen with the naked eye over the W.N.W. part of the horizon. He is travelling through Taurus south of the Pleiades ("The Stars in their Seasons," Map I.). Venus is also an evening star, and attains her greatest eastern elongation (45° 27′) at 6 o'clock in the evening on May 2. It is getting on towards midnight ere she sets close to the N.W. point of the horizon. She is a most brilliant and conspicuous object. She is travelling from Taurus into Gemini (same Map). Mars looks simply like a big red star. His position may be found in the Zodiacal Map on p. 70. Jupiter must be looked for as soon as ever it is dark enough, as he is approaching the west. He is, as shown by the Zodiacal Map on p. 40, in Cancer. During the next fourteen days the following phenomena of his Satellites will be visible. To-night (the 25th) the egress of Satellite I. will occur at 8h. 52m., as will that of the shadow it casts at 10h. 9m. p.m. On the 28th Satellite III. will reappear from occultation at 10h. 49m.; only, however, to suffer subsequent eclipse at 12h. 23m. 8s. The transit of Satellite II. will begin at 10 o'clock on the night of the 30th. The observation of the ingress of its shadow 28 minutes after midnight is problematical. On May 1 Satellite I. will be occulted at 11h. 12m. p.m., and the transit of Satellite IV. commence 12 minutes after midnight. This last phenomenon should be watched if possible, as the satellite will probably cross Jupiter's face as a dark spot, like its own shadow. On the 2nd the transit of Satellite I. begins at 8h. 29m. p.m.; and that of its shadow at 9h. 44m. Satellite II. will reappear from eclipse at 10h. 9m. 13s.; Satellite I. pass off Jupiter's face at 10h. 49m.; and its shadow follow it at 4 minutes after midnight. On the 3rd Satellite I. will reappear from eclipse at 9h. 13m. 53s. p.m. Satellite III. will be occulted at 11h. 23m. on the night of the 5th. On May 9th the egress of the shadow of this same satellite (III.) will happen at 9h. 59m. Satellite I. will begin its transit at 10h. 26m., and be followed by its shadow at 11h. 38m. p.m. Saturn is even worse placed than Jupiter, and is rapidly leaving us for the season. He is in Taurus, and will be nearly due North of Aldebaran when these notes begin. Uranus continues to be fairly well placed for the observer. He is in Virgo, where his path may be traced on the Zodiacal Map on p. 165. Neptune is lost in the glare of sunlight. The moon is 29·3 days old at noon to-day, 0·9 day old to-morrow, and obviously 13·9 days old at the same hour on May 9. Three Stars will be occulted by the Moon during the next fortnight. The first is ω Leonis, a 6th magnitude one, which, on the evening of May 2, will disappear at the Moon's dark limb at 7h. 43m. at an angle of 37° from her vertex, to reappear at her bright limb at 8h. 36m. p.m. at a vertical angle of 318°. Then on the 8th, λ Virginis of the 4½th magnitude will disappear at the dark limb of the moon at 9h. 12m., at an angle of 79° from her vertex, reappearing at her bright limb at 10h. 24m. p.m., at an angle from her vertex of 213°. Lastly, on May 9, the 6th magnitude star ν^1 Libræ will be occulted at 9h. 16m. at a vertical angle of 350°. The disappearance will really take place at the dark limb, but the moon will be so nearly full that it will look as though the star vanished behind a bright one. The reappearance at the bright limb happens at a point 291° from the moon's vertex, at 9h. 57m. p.m. The moon is in Aries until three o'clock to-morrow afternoon, when she enters Taurus; and it takes her until midnight on the 28th to cross the last-named constellation. She then passes into the extreme northern part of Orion. Her passage through this occupies eleven hours, after the lapse of which she crosses into Gemini. She is travelling through Gemini until two o'clock in the morning of May 1, at which hour she enters Cancer. She quits Cancer for Leo at 4 p.m. on the 2nd, and four-and twenty hours later descends into Sextans; whence she re-emerges into Leo at 11 a.m. on the 4th. She enters Virgo at 1 p.m. on the 5th. She takes until 11 o'clock on the night of the 8th to pass through this great constellation, and at that hour crosses the boundary into Libra. She is still travelling through Libra when our notes terminate.

According to a paper by Dr. N. H. Stone, in *Nature*, the resistance of the human body with a current of 3·6 volts, as found by experiments with a few patients, may be roughly given as from 1,200 to 1,500 ohms from foot to foot or from foot to hand, contact being made by means of brine baths.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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THE BACH INCIDENT AND MR. OWEN.

[1199]—In your paper of April 4 appears one of a series of articles. The one in question refers to the Bach incident, published by my father, Robert Dale Owen, in his "Debatable Land between this World and the Next." Will you be good enough to give me space in your paper to meet, if possible, a few of the objections which you present?

You kindly say "that the converts should not be ridiculed," hence I feel prompted to reply to so fair an opponent—a fairness with which spiritualists do not always meet.

I was with my father a portion of the time while he was gathering the material for his books, and I can therefore testify that no one could use more indefatigable care in collecting facts. He sometimes spent days in verifying the most insignificant details, travelling from place to place, and sparing neither time nor trouble. I have never known a lawyer so conscientiously discriminating in collecting evidence as was my father. If human testimony may be trusted in a court of law, then surely it should be received when thus carefully gathered in the interests of a higher tribunal.

In many instances, lawyers, jury, and witnesses may be bribed; but in my father's case, and in that of many others, there was no temptation to prevaricate. Spiritualism is not so popular that a man would in any way perjure himself to be ranked among its converts. I can well remember when my father decided to publish the vast evidence collected through years of investigation, continued first through months in his own drawing-room, and afterwards in a more extended field. He had an established reputation as a statesman in America; he was Minister to Naples when he first accepted the fact of spirit communion, and he thought that through the avowal of his belief he would lose the high position which had been won through years of public duty.

Even at this present time it requires some courage to acknowledge oneself a spiritualist, but twenty-five years ago it required much more.

One great difficulty encountered by my father was to induce people to communicate their experience at all; they feared to incur the world's contempt, and in many cases obtained it for their avowals.

Under such circumstances witnesses, as a rule, do not manufacture evidence. I do not claim that there have not been some hysterical and morbidly imaginative people whose testimony is not trustworthy, for there are many such both within and without the ranks of spiritualists; but if human evidence taken *en masse* can ever be trusted, it is when such evidence is given at a personal sacrifice to the witnesses. No one likes to be laughed at, and spiritualists share this trial with the rest of humanity.

I quite agree with you, however, that no one should believe "such stories" until he has investigated for himself, but neither should he disbelieve them until he has so investigated.

There are a sufficient number of sound-minded men and women in the ranks of spiritualism at the present time to warrant respect, and to demand from other sound-minded men and women who have not investigated its phenomena an unprejudiced neutrality.

If you will give a little further thought to the subject, you may be inclined to reconsider the sentence in which you say, "It ought to be shown that the well-being of the human race is to some important degree concerned in this matter . . . . before the philosophers can be expected to devote much of their time to the inquiry

suggested." Does it require any argument to show that the question of a future life is a subject of sufficient interest to engage the attention of even the most profound philosopher? And can there be any way of proving this all-important truth except as we can do so by communicating with those who have passed through the death of the body and yet live?

It is often the painful duty of spiritualists to answer appeals from death-robbed unbelievers, whose philosophy is unable to give them comfort when suffering a heavy loss. A negation may suffice as a neutral background to positive well-being and happiness, but a negation has never filled a vital human want. Even within a few weeks I have been grieved for sceptical friends, who, in happier moments, believed their theories offered a safe refuge in time of need. One comes sorely to dread unbelief when one sees, as I have, the suffering of bereaved unbelievers.

Concerning your objection as to the triviality of the messages, I have found through a life-long experience that many of the thoughts suggested are not trivial. Believing that the soul passes into the life beyond in the same state that it passed out of this existence, we do not wonder that some of the communications are unimportant; we unfortunately find in this world many men and women who are not profound either in thought or feeling; and these shallow streams are as noisily obtrusive on that side as on this? Is it not a wise dispensation that this is the law? Growth cannot be an attribute of the infallible; were we, therefore, to have free intercommunion with angels, whose judgment in all things was perfect, and we were, therefore, not called upon to use our own reason and discrimination, would not such communion lift us by artificial means to an exalted position which we had in no wise won by that individual effort, that experimental progression, which only can give us full-rounded moral muscle? Man is not prepared as yet for plenary inspiration.

Further, if we are to reject a belief in intercommunion between this world and the next because those who communicate are not perfect, then we must also reject humanity for the same reason. But we can scarcely affirm that there are no human beings because some of them are foolish or wicked, neither would it be wise to isolate our lives because our fellow creatures are not quite satisfactory.

To a philosopher such imperfection should not be a stumbling-block, but rather a test of genuineness, for philosophers should realise more fully than less careful students, how slow is the progression of any growth, how gradual and consecutive are the upbuilding processes even in the physical world. The law makes no leap.

Were spiritualists to claim that a murderer becomes an angel in the twinkling of an eye, then the philosophers might object to investigating a theory so contrary to their own experience, but we make no such claim; we know that we are all interlinked in a great progressive scheme wherein there are innumerable shades of differing growths, we feel that we must have an infinite patience with lower spirits, even as higher spirits have an infinite patience with us.

If you will give your attention to the study of the laws which bind the worlds of matter and spirit, you will find, I think, a wide and subtly interesting field of research, and I venture to affirm that you will discover it to be a subject, not only worthy of philosophers, but one requiring the most conscientious search of the greatest hearts, the most continued thought of the wisest brains in the world. ROSAMOND DALE OWEN.

[I am myself unable to understand why any one who possesses evidence apparently substantiating spiritual or ghostly theories should hesitate to produce it. Holding it back implies doubt as to its validity. That my correspondent's father was not among those who sought to deceive, all who knew him know. But that he was not deceived is by no means so well attested. I do not wish spiritualistic notions to be discussed in these columns, for the simple reason that so much deception has been attempted and detected. But well attested facts are always admissible, as they have a scientific interest:—first, because there must be *some* explanation, and the search for an explanation of observed facts is good practice; secondly, because by noting the facts on which erroneous opinions have been based we learn how to gauge the average intellect.—R. P.]

APPARITIONS.

[1200]—Mr. Rudd's suggestion that apparitions (*vivid dreams*) may be due to one hemisphere of the brain being in the state of sleep and dreaming, while the other performs functions for the man consciously awake, has, as he admits possible, been made before.

Many may have entertained the same idea. Mr. Sergeant Cox, in "The Mechanism of Man," Vol. 2, 1879, where he devotes sixty pages to the subject of sleep and dreams, adopts almost identically the same, namely that one hemisphere is awake, the other asleep See pages 106, 128, and 129 of his book.

In the first edition of his work, published in 1874, he expresses the same opinion. EYE WITNESS.

VISIONS.

[1201]—In my letter published in KNOWLEDGE (1147, of March 14) I related singular visual experiences which I had had, extending over a period of fourteen days. These continued for at least a week afterwards, but have since entirely ceased, owing, as I imagine, to their cause being removed; and as this may have some interest for men of science and opticians, I venture to ask for space to relate a suggestion as to their origin which has since occurred to me.

During the three weeks in which I was subject to seeing curious scintilations of light in the hours of darkness I was engaged each evening till bedtime in searching out and comparing certain passages in a badly-printed book of small type, and though I am not in the habit of wearing glasses, I found it convenient to use occasionally a magnifying glass of strong power in this work. The light of a lamp passing through this frequently caused bright rays of light to rest upon the book; these did not at the time cause me any inconvenience; but it has struck me that they may have become, as it were, photographed on the retina of the eye, and have been reproduced as I there described; and I suppose, therefore, that the scintillations I spoke of were not due to some mere subjective cause, "or of internal origination" within the optic ganglia, as Mr. Wilson, in his letter 1174 of KNOWLEDGE, April 4, appears to think was probably the case. COSMOPOLITAN.

COINCIDENCES.

[1202]—Here is a trivial example of a coincidence which may not be absolutely without interest as an illustration. In the *Standard* for the 7th inst. I read this paragraph:—"The name of the midshipman whose gallant conduct, in connection with the death of Lieutenant Montressor, was mentioned by our Souakim Correspondent, was Tyndale-Biscoe." I never, to my knowledge, met with the uncommon double-barrelled name of this plucky young officer before; but, taking up the paper on the succeeding morning (the 8th), I find another Mr. Tyndale-Biscoe figuring as the coxswain of the winning boat in the University Boat Race.

[Here is another odd little coincidence—I write a letter to my agent Mr. J. Stuart, and being interrupted while addressing it, write only his name and the words "Royal Conc." The letter is posted in Kew. One would say it was bound to come back to me through the dead letter office. Not at all. My wife chances to call the same evening on a lady of the same name as my agent. The letter is brought in while she is there, is recognised by her as in my handwriting, and is forwarded unopened by the same post which would have taken it had it been rightly addressed.

"No, sir, I am *not* in the habit of wrongly or imperfectly addressing letters. I never made such a mistake as this before to my knowledge."—R. P.]

[1203]—The following curious case of coincidence occurred many years ago, when my family resided near Keswick, in the Lake District, I being a boy at the time. I was walking one day with a friend along the road to Newlands, when our conversation turned on flowers. I remarked to him how curious it was that in the whole neighbourhood—say within a radius of at least eight or ten miles—there were no wild cowslips. Without being a bit of a botanist, I was always fond of gathering wild flowers, and there were few showy ones that I did not know. I therefore considered my never having, during many years' residence in the place, observed a cowslip out of a garden, fair evidence that the plant did not exist in a wild state. Not more than a minute elapsed from the time I spoke, when, happening to glance down on the road side, I saw a cowslip. Now, I have been in the same neighbourhood a great deal since that day, but I have never *observed* another such flower. How it came to be growing where it was (near a side-road which leads to Nicol Ending boat-landing) it would be fruitless to inquire; it may have been planted by a bird, or a child from Portinscale, a neighbouring village (where there were gardens), may have planted it. No doubt the cause of its presence was most simple. But still there remains the curious coincidence of my speaking of a rare object and seeing it not more than a minute later.

I. R. CAMPBELL.

ORTHOPIC.

[1204]—Many thanks for courteous correction of errata (1190, April 11, 1884, p. 252).

In reply to question as to difference between the terminations "scopic" and "opic," I may be allowed to say that, in scientific

nomenclature, all instruments made to assist vision (except, I think, spectacles, and in those we have peri-scopic) are indicated by names ending in "scope" (from *σκοπέω*, I view), as micro-scope, tele-scope, stereo-scope, spectro-scope, pseudo-scope, &c. The corresponding adjectival forms of which, applicable to their respective phenomena, are micro-scopic, tele-scopic, &c.

But vision with naked eye is indicated by opia, from *ωψ*, an eye; hence, short-sightedness is called my-opia; far-sightedness (or rather aged-sightedness), presby-opia; double-seeing, bi-opia; correct seeing, orth-opia (from *ορθος*, correct); and false-seeing, pseud-opia (from *ψεῦδος*, falsehood); and *their* corresponding adjectival forms, applicable to unaided vision, are my-opic, presby-opic, bi-opic, orth-opic, and pseud-opic. That "orthopic" and "pseudopic" do not involve any physical "impossibility" is manifest from "Cosmopolitan's" original letter (1147).

The whole subject is very fully discussed in a charming book, "Vision, Pseudopia," by Edward H. Clarke, M.D., edited by Oliver Wendell Holmes, M.D., published by Houghton, Osgood, & Co., Boston, U.S. WILLIAM WILSON, M.A., LL.D.

[The words "orthopic," "pseudopic," &c., seem to me open to serious objection. "Myopic" and "presbyopic" are all right, because the word compounded with "op" really characterises the "eye,"—"closed-eye" and "aged eye" we understand, but false-eye and right-eye have no proper relation to false seeing and right seeing. A myopic is one who sees with half-closed eyes as a short-sighted person does, a presbyopic one who sees with aged eyes; but a pseudopic is not one who sees with false eyes. So at least it seems to me.—R. P.]

THE "NATIONAL" TRICYCLES.

[1205]—As Mr. Browning's errors of last week seem likely to damage a very trustworthy firm, will you permit me to correct them?

The "Sparkbrook National" is constructed by the Sparkbrook Manufacturing Company, Sparkbrook Works, Coventry. It is a central, or side-geared front-steerer, of first-class construction, and its makers do *not* claim that it may be driven up a flight of stairs.

The stair-climbing machine is a "Royal National," made by the National Cycle Company, also of Coventry. It is a direct-action machine, and *cannot* be central-geared. Mr. B. has confounded the two makes. GALLUS.

P.S. The accident alluded to by Mr. B. was that which resulted in the death of Mr. A. A. Broad. He fell off a "Royal National" direct-action stair-climbing machine down-hill, and the jury described the brake as ineffective.

A TRICYCLE PROBLEM.

[1206]—"D. M." asks, in letter 1189, why a tricycle wheel leaves a double rut in dust. I have watched the production of the phenomenon referred to long before the invention of tricycles. This little ridge of dust in the middle of the wheel-track is piled by the air rushing from each side into the wake of the wheel. It is the upward motion of the hinder part of the tire which gives rise to the effect. M. H. C.

IMPRESSION OF TRICYCLE TYRES.

[1207]—I have frequently observed the impressions left by the wheels of a tricycle, as referred to by "D. M." in last week's KNOWLEDGE. I think the peculiar form of the impression is simply due to the alternate expansion and contraction of the rubber tyres. When the tyre is revolving on a dusty road, that part in actual contact with the road (bearing the greatest weight) is flattened, and therefore leaves a depression rather wider than the tyre. The ridge in the centre is caused by the contraction of the tyre immediately after it has passed its point of contact with the road. This contraction of the rubber (from either side of the depression) draws the dust to the centre of the tyre, and thus forms a ridge in the centre of the depression, so that, as long as the wheel revolved, there would be continual expansion and contraction, causing trough and ridge.

The absence of the ridge from a trough made by a tyre in mud might be due to one of two causes: either the mud sticks to the tyre and obliterates the evidence of contraction, or, the mud may be too tenacious to be drawn to the centre of the trough and "ridged" by the contracting power.

I have made no experiments to test the accuracy of my opinion, although I have held the same for some years.

On first noticing it I attributed it in some way or another to the air under the tyre, at the point of contact, being expelled, and rushing in again from behind to fill the vacuum, carrying a certain amount of dust with it, which, when deposited, would form a ridge.

Interesting experiments of this kind can be tried, and "dendritic" markings be artificially produced. If two pieces of smooth slate be wetted and rubbed together until they become sticky, and then suddenly drawn asunder, the mud produced by the attrition will assume the form of tree, fern, sea-weed, or something "dendritic."

I have often observed the same effect produced by a "dry process" when walking along a dusty pavement on a still day, for when the sole of the boot is lifted from the pavement in walking, dendritic markings will be formed in the dust impressed by the foot. The finer the dust the more perfect are the markings. That ancient fossil, the *Oldhamia radiata* of the Cambrian rocks (supposed to represent a kind of sea-weed) is believed by *some* geologists to be nothing more than a "marking," caused, probably, by one of the processes aboved-named, and thought to be so because a weight suddenly lifted from a piece of tissue-paper will produce markings not unlike *Oldhamia*. C. CARUS-WILSON, F.G.S., F.R.G.S.

"TWINKLE, TWINKLE LITTLE STAR."

[1208]—*Quandoque bonus dormitat Homerus.* "F.R.A.S," in his valuable essay on "Scintillation," infers that the famous "Twinkle, Twinkle Little Star," &c., was written by Dr. Watts. Not so; it was the Sisters Taylor (Jane and Ann) who, in their "Original Poems for Infant Minds" (published fifty-five years after the death of the pious doctor), first gave to the world this graceful little poem. The parodied lines commence "Scintillate, scintillate," and so forth. J. W. HOWELL.

NOTES OF SPECTROSCOPIC OBSERVATIONS OF COMET "PONS," JAN. 27 TO FEB. 2, 1884.

[1209]—The spectroscope used was a small direct-vision compound prism, by Browning, the telescope being a refractor of 3-in. aperture. After some difficulty in getting the object focussed upon the slit of the spectroscope, there flashed out three bright bands. They appeared somewhat pyramidal in form, the base being on the south side of the telescopic image. The relative spaces between them appeared about as 2 to 3. I could not distinguish any difference, or even any trace, of colour; they appeared rather to resemble a phosphorescent glow. I had not the means at the time of determining their relative positions in the spectrum, having left the reflecting prism at home. On subsequent evenings, however, I took every precaution for determining this point.

On the evening of January 29th, I succeeded in getting the spectrum of a gas-flame (common coal-gas) turned down to a minute point of blue flame, in juxtaposition with the spectrum of the comet, when, to my surprise and gratification, I found that the three comet lines coincided perfectly with the three conspicuous lines shown in the gas spectrum, the principal difference between the two spectra being that the gas showed a faint continuous spectrum, showing all the colours, whilst that of the comet had perfectly dark spaces between the lines, and, so far as I could discern, no colour. I cannot say, however, that I might not have obtained a continuous spectrum from the comet had I been able to grasp more of its light. Such seemed to be suggested by the fact that the lines were broadened out towards the violet end, gradually fading away on that side, but were pretty sharp and decided on the side next the red.

By a contrivance of my own, designed specially for double star measurement, I was enabled to project a dark-field "ghost" scale into the field of the spectroscope, and thereby got the relative positions of the lines from the sodium line, D. This line I obtained by sprinkling a little salt in the gas-flame. The mean of several observations gave the following results, the readings of my scale being reduced to that of Roscoe's frontispiece for comparison. The line D being at 50, the comet lines stood at 59·3, 72·2, and 99·5. Roscoe's carbon lines stand at 60, 76, and 100; also another group at 123 to 128. This latter, however, I did not detect. I think this agreement very close, and what little difference there is may well be accounted for by a difference of material of the prisms and the difficulty of measuring. I may mention that I took the precaution of scaling the principal solar lines during the preceding afternoon, for the purpose of comparison.

It was evidently chiefly, if not entirely, the *nucleus* that gave the lines; as, on the briefest stoppage of the driving-clock, the lines instantly disappeared. A. B. BIGGS.

THE GOODWIN SANDS.

[1210]—Our Kentish saying is that "Tenterden steeple was the cause of Goodwin Sands." The legend is that long ago the Goodwin Sands were a tract of valuable land lying rather below the high-water level, the sea being kept out by embankments, as it is at this time on many parts of our coast. The money which ought to have been spent annually in keeping the "sea-walls" in proper repair was laid out, it is said, in building Tenterden steeple. The

natural result followed. The sea-wall became weakened, and at last, during a violent storm, the sea burst in, and could never again be excluded. So a tract of valuable land was converted into a dreary waste of sand only exposed at low tide, and which has been the grave of hundreds of brave sailors.—Yours truly,

A MAN OF KENT.

LETTERS RECEIVED.

WILLIAM SECUNDUS. Do not know of any receipt for skeletonising birds. Our Query Column long since closed.—W. GLASSFORD WALKER. (1) Know of no sure remedy for smoking chimneys. (2) No reactionary effects follow discontinuance of exercise. (3) Moisture gathers on glass if the air in its neighbourhood is saturated for a temperature higher than that of the glass. Thus, suppose the air inside the glass shade is at a temperature of 60°, and the quantity of moisture such that the air would be saturated at a temperature of 50°, then if the air outside is at a temperature of, say, 40°, the layers next the glass on the inside must give up a part of their moisture in the form of water-drops. As a matter of fact, the air inside a fern-shade is always very nearly saturated.—W. MILLER. Thanks; but those maps are not coming out *weekly*.—A. B. Know of no work on mental arithmetic.—FOLIO. I fear the time has not yet come for a complete popular edition of my works in twelve shilling parts. Alas! my publishers are obliged to ask fifteen shillings for my Library Atlas alone, and I am guilty of forty works in all.—H. DARNSELL. I have forgotten what I paid for my object-glass and eye-pieces. Any optician would answer your question better than I.—H. GOLDURGH. I never answer by post; moreover, I do not know.—A BEGINNER. Your calculation would be quite correct were the atmospheric absorption of heat less important than it is. As matters actually are the heat received from the sun at mid-day in summer is much more than 3·7 times as great as that received at mid-day in winter. —P. F. KERR. Will think over the constellation lore question.—RICHARD PRICE. *Exact* speed of light has not yet been determined. About 187,000 miles per second.—W. W. FAWCETT. Whether the earth is creeping in towards the sun? — In the words of the eloquent Bishop Peter of Rum-ti-foo:

I do not say it ain't,
But *Time!* my Christian friend.

The year has not diminished ten seconds in length during the last 2,000 years, that is not by 1-3,156,000th part of its length. Since the cube of the distance varies as the square of the period, the distance varies as the period to power two-thirds; and therefore the distance has not changed in 2,000 years by two-thirds of the 1-3,156,000th part, or by 1-4,734,000th of about 92,700,000 miles—say in round numbers 20 miles, or one mile in 100 years. Since at this rate 100 millions of years would only reduce the distance by 1 million miles, or less than a third of the actual range of distance due to the eccentricity of the earth's orbit, it did not seem to me necessary to alarm my audience by any reference to the earth's future absorption by the sun. It won't happen in our time.—A LADY MATHEMATICIAN. Your letters leave me in doubt whether I should address you as babe or as fossil. Allow me to raise my hat to you and pass on.—T. H. No, certainly. A. McD. makes simply a statement which relates to a matter of fact. I will assuredly not insert the simply hateful and untrue doctrine which you find obvious and pleasing. Why on earth should a man be incapable of thinking and acting aright because what you think so certainly true seems to him indifferent or doubtful or worse? As I happen to know that your view is entirely incorrect, I have a *raison de plus* for not inserting your communication.—SENEX. I scarcely think the storm had carried away *your* electricity. With the progress of the storm the electrical condition of the air changed and the phenomena you had noticed ceased; but probably your own condition was much the same all through.—E. T. The outer satellite appears to have a darker surface than the others: but they all look dark when on the brightest parts of the disc of Jupiter.—JAS. GILLESPIE. Tycho Brahe's old objection, long since met and disproved.—J. R. SUTTON. Your letter is an angry one and therefore naturally unwise. It certainly never occurred to me that your imperfect communication was intended as an article! You yourself point out that "it was incomplete"; and in another place describe it very justly as "a half-reasoned paper." Yet you claim that it should have appeared as an article! and, if I understand aright your remark that "time is too valuable to" you for you to "afford to waste it in useless letter-writing," you consider that you should have been paid for your "incomplete, half-reasoned paper"! Still only half-reasoning, or perhaps in your anger not reasoning at all, you deliberately charge me with dishonourable conduct in allowing it to appear (which *I* thought a favour to you) among the letters. You remark further—or rather you begin your letter with the remark—that the communication was sent me "in mistake"; "it should never have been sent at all." To that portion of your extraordinary communication I beg to express my perfect assent. Note, however, that it was *your* mistake, not mine.—C. R. Mr. Hampden, like the original earth-flattener Parallax, is very clever in that sort of argument. Taking a tangent line to the earth's surface, you get for a distance of 65 miles a height above the surface of $(65)^2 \times 8$ in. (8 inches being the depression for one mile), that is, some 3,063 feet. But the real problem is not thus dealt with. Two considerations are conveniently overlooked,—first, the line of sight is slightly curved by atmospheric refraction (the setting sun illustrates this, which also follows inevitably from known optical laws), so that the actual departure of a tangent line of sight from the earth's spherical surface is about 6 in. for a mile; secondly, the height of the observer's eye above the sea-level makes a very great difference in the estimated depression. I do not know at what height the photographic camera was set when the mountains in Man were photographed from Blackpool. I suppose it was at about the height you mention in the case of your own observations—or 300 ft. above the sea-level. [At the top of a tall house in Blackpool, such a distance would easily be obtained at low tide.] Then we have—Distance of point of contact of line of sight with sea-surface, taking 6 in. or half-a-foot for dip from optical tangent line in one mile, is $\sqrt{600}$ miles, or close on 25 miles. For the remaining 40 miles we get a depression of $(40)^2 \times 6$ in. or 800 ft. In certain conditions of the air,—conditions generally present when the air is clear enough to show Man from Blackpool, the refractive effect of the air is even greater, and probably 5 in. instead of 6 in. might be allowed for one mile. But Man rises much more than 800 ft. above the sea-level, especially at the time of low water. The Mourne Mts. could be well seen in clear weather from an elevation of 300 ft. near Dublin, 70 miles away.—T. J. S. I have not seen that narrative. Should be glad to quote it, if you have it by you.—J. MALET. The geological evidence is not needed. Prof. G. Darwin's mathematical demonstration suffices to prove, beyond all doubt, that the real globe of the sun is very much smaller than the globe we see.—RAPHAEL K. MAY. I agree with you it is a great pity that two meanings have been given to the words billion, trillion, &c. The meaning given in this country is undoubtedly the correct one, as it is the only one which gives any significance to the bi, tri, quadri, &c. A billion is (a million)^2, a trillion is (a million)^3, a quadrillion is (a million)^4; and so forth. But in America and on the Continent, a billion = 1,000 million, a trillion = 1,000,000 million, and so forth.—F. A. M. If gravity took appreciable time at its work, say it acted only as quickly as light travels, the pull of the sun on the earth would not be directed towards the sun's centre. There would be always a force tending to draw the earth onwards tangentially. This in the thousands of years over which astronomy extends its survey would have produced a measurable change even in the position of the earth's orbit.—SUBSCRIBER. He is considered very skilful and to know more than most men on the subject.—M. Still your ring reflector would not do. Consider for instance the case of rays proceeding from a point not in the axis (produced) of the cylinder. A telescope which only focussed along its optical axis would be of rather small use.—R. A. H. Thanks, article delayed—but shall appear. The subject is important. — G. LAPTHORNE. The path of Jupiter, marked in among known stars, unintelligible! My dear sir, what was there to explain?—R. HODGSON. I have not by me the letter or address of "Cosmopolitan," and it would not be consistent with rules to forward them; but I have no doubt he will be ready to give any information you may require. I think your communication of April 4 can hardly have escaped his attention. The matter relating to eight gateways of knowledge might, if somewhat abridged, appear as a letter; but there is not sufficiently general interest in the subject to justify its insertion as an article.—F. M. Thanks for explanation of tricycle problem, which agrees with others received (one or two published).—STEPHEN BURRELL. A reformed alphabet in which all could agree would be worth considering; but remembering how Mr. Pitman destroyed all chances of the phonetic system being generally considered by introducing changes, we prefer to wait until a definite plan is adopted by the whole body of reformers. —J. HARRISON. Thanks. Your suggested limits to alterations in constellation maps agree with my own views closely.—E. R. COX. Thanks for reminding me.—[F. THOMPSON. No wonder you are angry to see the very secretary of the Zetetic Society converted from his mistake. There was never any idea of discussing Parallax's arguments: they are too utterly worthless.—SUB.-ED.]—PASCAL. But has any one found any difficulty in determining the superfices of rectangles?—C. T. B. Such queries not suitable for these columns.—C. R. The subject is infinitely difficult. Unfortunately our space is finite. But I agree with you that it is as difficult to form an idea of the infinitely small as of the infinitely great.—ORPHEUS. The story seems to have been discredited 130 years ago, and is scarcely likely to get credit now.

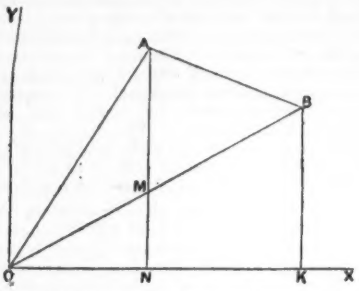
Our Mathematical Column.

EASY LESSONS IN CO-ORDINATE GEOMETRY.

By Richard A. Proctor.

(*Continued from page 254.*)

14. *One angle of a triangle is at the origin; it is required to determine its area in terms of the co-ordinates of the other angular points.*



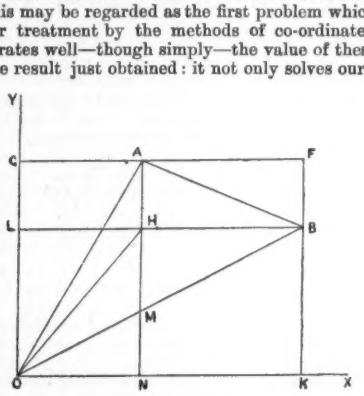
Let A B O be a triangle; x_1 y_1 the co-ordinates of A; x_2, y_2, those of B. Suppose x_1 less than x_2. Draw B K, A N, perpendicular to O X, A N cutting O B in M; then

$$\begin{aligned}\triangle ABO &= \triangle OAM + \triangle AMB \\ &= \tfrac{1}{2} AM.ON + \tfrac{1}{2} AM.NK \\ &= \tfrac{1}{2} AM\,(ON+NK) \\ &= \tfrac{1}{2}(AN-NM)\,OK.\end{aligned}$$

$$= \frac{1}{2}\left(y_1 - \frac{x_1}{x_2}y_2\right)x_2, \text{ since } NM = \frac{ON}{OK}.BK.$$

$$= \tfrac{1}{2}(y_1x_2 - y_2x_1)$$

It will be worth while to consider for a moment what this result means. This may be regarded as the first problem which has come before us for treatment by the methods of co-ordinate geometry, and it illustrates well—though simply—the value of these methods. Consider the result just obtained: it not only solves our problem it



presents a theorem. Draw the parallels G A F, K B F, A H N, L H B: then our result tells us that

$$\triangle ABO = \tfrac{1}{2}(\text{rect. } GK - \text{rect. } LN)$$

a result worth noticing, though of course the geometrical proof is sufficiently simple. We join H O, and see at once that the three triangles into which A B O is divided by the lines A H, H O, H B, are equal to half the rectangles G H, H K, H F. But the analytical demonstration of the area of the triangle gives us this result at once, and as something thrown in.

The expression for the area is quantitatively correct whatever the values of x_1, x_2, y_1, and y_2; but it is negative if y_1x_2 is less than x_1y_2, or if

$$\frac{y_1}{y_2} < \frac{x_1}{x_2}$$

Now since M N : B K :: O N : O K

$$\text{or } \frac{MN}{y_2} = \frac{x_1}{x_2}$$

we see that our expression for the area is positive or negative according as y_1 is greater or less than M N.

The reader will find it a useful exercise to take the points A, B in other positions, within or without the angle Y O X, interpreting the meaning of the result geometrically for each case thus arising.

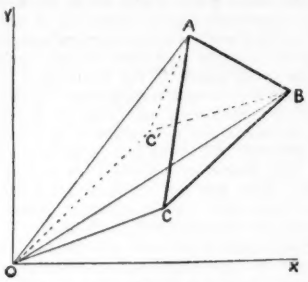
15. *To determine the area of a triangle* A B C, *the co-ordinates of* A *being* x_1, y_1; *of* B x_2, y_2; *of* C x_3, y_3.

Join O A, O B, O C, and let the values of x_1, y_1, &c. be such that the lines O A, O B, O C, fall as shown,—O A farthest from O X, O B next, O C nearest. Then

$$\triangle ABC = \triangle AOB + \triangle BOC - \triangle AOC$$

$$= \frac{1}{2}\left\{(y_1x_2 - x_1y_2) + (y_2x_3 - x_2y_3) + (y_3x_1 - x_3y_1)\right\}$$

It will be seen that we have taken for BOC its proper positive expression, while for AOC we have used the negative expression (y_3x_1 being manifestly less than x_3y_1), and therefore altered the negative sign outside to the positive.



The expression thus obtained will always represent quantitatively the area of the triangle, but it will be positive or negative, according as

$$y_1x_2 + y_2x_3 + y_3x_1 > = \text{or} < x_1y_2 + x_2y_3 + x_3y_1.$$

We need not trouble ourselves to consider the effect of this condition, as every case that can arrive yields its own interpretation. the reader will do well however to consider several cases, as that will give useful exercise to him. Thus suppose C′ the position of the third angle, then

$$\triangle ABC = \triangle AOB - \triangle BOC' - \triangle AOC'$$

but the same expression results, for $\triangle$BOC is now expressed not by $y_2x_3 - x_2y_3$ but by $y_3x_2 - y_2x_3$.

16. *The expression for the area may be written also in either of the following symmetrical forms:—*

$$\frac{1}{2}\left\{y_1(x_2-x_3) + y_2(x_3-x_1) + y_3(x_1-x_2)\right\}$$

$$\frac{1}{2}\left\{x_1(y_3-y_2) + x_2(y_1-y_3) + x_3(y_2-y_1)\right\}$$

$$\frac{1}{2}\left\{x_1y_3 + x_2y_1 + x_3y_2 - x_1y_2 - x_2y_3 - x_3y_1\right\}$$

The result of 15 may be obtained somewhat differently as follows:—If the origin of co-ordinates be removed to C, the axes remaining parallel to their original directions, the new co-ordinates of A and B are by 8 (p. 213) (or obviously)

(x_1-x_3), (y_1-y_3), and (x_2-x_3), (y_2-y_3), respectivel

Hence by Art.

$$\triangle ABC = \frac{1}{2}\left\{(x_2-x_3)\,(y_1-y_3) - (x_1-x_3)\,y_2-y_3)\right\}$$

which reduces immediately to one of the forms just obtained.

Or the result of 15 may be obtained independently in the manner manner of 14. We should obtain by means of 12 (p. 253)

$$\triangle ABC = \frac{1}{2}\left\{y_1 - \frac{(x_1-x_3)\,y_2 + (x_2-x_1)\,y_3}{(x_1-x_3)+(x_2-x_1)}\right\}x_2-x_3)$$

$$= \frac{1}{2}\left\{y_1(x_2-x_3) + y_2(x_3-x_1) + y_3(x_1-x_2)\right\}$$

a form already obtained.

Some particular cases may be noted. Thus if $x_2=0$ and $x_3=0$, that is, if one side of the triangle lies upon the axis of y, then the area

$$= \frac{x_1}{2}(y_3-y_2)$$

Similarly if $y_2=0$, and $y_3=0$, the area

$$= \frac{y_1}{2}(x_2-x_3)$$

Lastly if $x_3=0$, and $y_2=0$, or one angle lies on the axis of y and another on the axis of x, the area

$$= \frac{1}{2}\left\{x_1y_3 - x_2y_3 + y_1x_2\right\}$$

which may be written in either of the forms

$$\frac{1}{2}\left\{x_1y_3 + x_2(y_1-y_3)\right\}, \text{ or } \frac{1}{2}\left\{x_2y_1 + y_3(x_1-x_2)\right\}$$

(*To be continued.*)

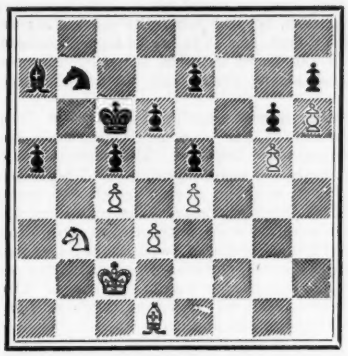
Our Chess Column.

END GAME STUDY.

By Mephisto.

Bishop and Knight.

Black.



White.

White to play and win.

We offer a copy of Bird's "Masterpieces" for the best analytical solution of this Ending.

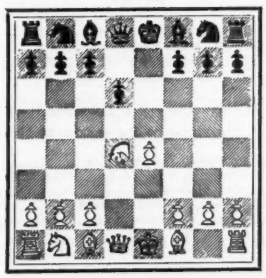
EASY NOTES ON THE CHESS OPENINGS.

By Richard A. Proctor.

Besides the mistakes already mentioned there is another which young players very often make,—that of starting an attack too hastily. This always leads, if properly met, to an inferior position, for the over-hasty advance has to be followed by a hasty retreat, and the moves made both in the advance and retreat are so many moves wasted.

Returning to our opening, we will now suppose that after the moves 1. P to K4 / P to K4 2. Kt to KB3 / P to Q3 3. P to Q4 / P takes P White plays 4. Kt takes P instead of 4. Q takes P. The position is now

Black.



White.

Position after 4. Kt takes P.

I am rather heterodox in regard to this move, which is usually considered as at least as good as 4. Q takes P. Neither seems to me really good; in fact the continuation 3. B to QB4 seems to me sounder than 3. P to Q4. But for reasons akin to those which cause the move 4. Kt takes P in the Scotch Gambit (which only differs from the above in Black's second move being 2. Kt to QB3) to be regarded as unsatisfactory, I hold the same move to be objectionable against the Philidor defence. Why Black's choice of a reply should be held to lie between 4. P to Q4 and 4. Kt to KB3 I cannot divine; for it seems to me that with the White Knight removed to a position whence he can be easily dislodged, Black has a choice of other moves for the development of his game. I have found 4. Q to KR5 effective at this stage, though it may not be altogether sound. White may more safely be allowed to try 5. Kt to QKt5 than in a familiar form of the Scotch Gambit, for Black can then play 5. Q takes P (ch), and if 6. B to K2 Black can reply 6. Q to QB3. The best reply to 4. Q to KR5 seems to be 5. Kt to QB3; if Black then plays 5. Kt to KB3 he will have to be careful lest his Queen be unpleasantly hampered. However, the books countenance no such response as 4. Q to KR5 in the position illustrated above. The lines of play approved of are given in the following columns:—

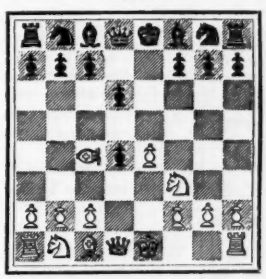
4.	P to Q4		Kt to KB3	
5.	P takes P	P to K5	Kt to QB3	
	Q takes P	P to QB4	B to K2	
6.	Q to K2 (ch)	B to QKt5 (ch)	B to Q3 (*b*)	
	B to K2	B to Q2	Castles	
7.	Kt to QKt5	P to K6	Castles	P to KB4
	Kt to QR3	B takes B	P to QB4	B to KKt5
8.	QKt to QB3	P takes P (ch)	KKt to K2	Kt to KB3
	Q to Q sq.	K takes P	Q to Kt3	P to QB3
9.	B to KB4	Kt takes B	K to R sq.	P to KR3
	Kt to KB3	Q to K sq. (ch)	Kt to QB3	White has the
10.	QR to Q sq.	Q to K2	P to KB4	better game.
	B to Q2	Q takes Q (ch)	White has the	
11.	Q to K5	K takes Q	better game.	
	Castles	Kt to QR3		
	Equal game (*a*)	Black has the better game.		

(*a*) White can now win the QB Pawn, but after the exchanges R to K sq. followed by B to QKt5 equalises the game.

(*b*) Or 6. P to KB4 / Castles 7. B to K2 / P to QB4 8. Kt to KB3 / Kt to QB3 Castles with the better game.

But the recapture of the Pawn by White at move 4, though thus shown to be safe, seems to me less sound Chess than the developing move 4. B to QB4, as in the best form of the Scotch Gambit. This leads to the following lines of play:—

Black.



White.

Position after 4. B to QB4

4.	B to QB4		
	Kt to KB3	B to K2	Kt to QB3
5.	Kt to KKt5	P to QB3 (*c*)	Kt takes P
	B to K3	P to Q6 (*d*)	Kt takes Kt
6.	B takes B	Q to QKt3	Q takes Kt
	P takes B	B to K3	Kt to K2
7.	Kt takes P	B takes B	Castles
	Q to K2	P takes B	Kt to QB3
8.	Kt takes QP	Q takes KtP	B to QKt5
	Q takes P (ch)	Kt to Q2	B to Q2
9.	Q to K2	Q to QKt5	B takes Kt
	Q takes Q (ch)		B takes B
	Equal game.	White has the better game.	P to KB4
			White has the better game.

(*c*) 5. Q takes P gives the same position as the fifth move in the second line following the position shown at p. 255, and White gets the better position.

(*d*) This was the move played by Barnes in a game against Paul Morphy. The object of the move is obvious. White cannot take the Pawn at Q's 6th without impairing his position. Had Black either played P takes P or left the Pawn to be taken by White's QBP, White's game would have been obviously superior to Black's, nor can Black safely defend the Pawn by 5. P to QB4, for the QBP is wanted for the defence of Black's entrenchments on the Queen's side.

Our Whist Column.

By Five of Clubs.

The Hands.

B { *Clubs*—A, Kn, 10, 5, 4. Hearts—Q, 9, 5, 4. / Diamonds—10, 5, 3. Spades—3. }

Y { *Clubs*—K, 2. / Diamonds—Kn, 8, 6, 4. / Hearts—K, Kn, 10, 7, 2. / Spades—K, 9. }

A B, 1. **B**

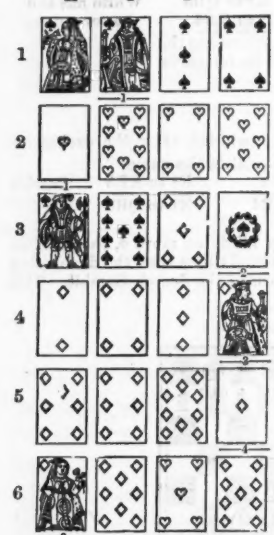
Y **Z**

Y Z, 4. *Trump.* *C.* 7.

A Leads.

Z { 3, 6, 7, 9—*Clubs* / 9, K, A—Diamonds / 8—Hearts. / 4, 5, 6, 8, A.—Spades. }

A { *Clubs*—Q, 8. Hearts—A, 6, 3. / Diamonds—Q, 7, 2. Spades—Q, Kn, 10 7, 2. }



Notes and Inferences.

1. *A* rightly leads Queen from Queen, Knave, Ten, to five.

2. *B* holding Heart Nine knows that *Z* has no more Hearts. He knows also that *Y*'s lead is from King, Knave, Ten, and others, so that after this round *Y* holds the major tenace in Hearts.

3. *B* rightly refrains from ruffing, though he knows *Z* holds the Ace. Not only to save his own strength in trumps but to get his partner's suit cleared, he lets the trick go to *Y-Z*. All the table knows that the remaining Spades lie between *A* and *Z*. *B* begins a late signal. His hand would not have justified an early one, but a late one is less imperative.

4. *Z* should have led through *A*'s strength in Spades. *B* has indicated length in trumps, so that forcing him would have been good policy for *Z*, who holds four himself.

6. *B* knows that Diamond Knave lies with *Y*; for since the Ten has been already played, the Knave would have been in sequence with *Z*'s 9, and would have been the right card for *Z* to have led had he held it. Clearly *A* does not hold it, or he would have played it as in sequence with the Queen and lower.

7. *A* responds to his partner's signal with his best trump.

9. *B* now knows that *Z* holds Club Nine and three Spades; that *A* holds a small Heart and three Spades, headed by the Ten; and that *Y* holds the long Diamond and major tenace in Hearts. *A-B* wanting three tricks to win.

10. *B* does not capture *Z*'s Club Nine with his Ten, for then he could make only two tricks, but leading the small trump lets *Z* win the trick, who must lead a Spade through *A*'s major tenace.

11, 12. *A* makes two tricks in Spades

13. And *B* one with his long trump. *A B* win the game.

Note.—The above game illustrates the importance of inferences made as the cards fall. *B* knows that he can lose nothing by letting *Z* take the 10th trick and *may* win, *Z* being obliged to lead through *A*'s strength.

Erratum.—In the game at p. 235, the trump card should have been Diamond Two instead of Diamond Queen.

Accident from Electric Lighting.—From New York it is reported that on the 14th inst. the *Rebecca Everingham*, a river steamer which was laden with cotton, and had forty-one persons on board, passengers and crew, had been totally destroyed by fire near the town of Florence, in the State of Georgia. The disaster is attributed to a fragment of the carbon of the electric light falling upon the cotton. Eleven deaths are known to have taken place, and it is feared that that number will be raised to twenty. The entire living freight of the vessel would have been sacrificed but for the splendid heroism of the pilot, who ordered his son to swim to the shore with a rope, and at the same time continued to steer the vessel towards the shore with the flames literally surging around him. By these means about half the number on board were saved.

The *Riachuelo*, a new ironclad built by Mr. Samuda for the Brazilian Government, has been fitted with compound engines by Messrs. Humphreys and Tennant. The engines are claimed to be the best ever made, and have indicated 4,537 horse-power for three hours' consecutive working, during which the consumption was 1·38 lb. per horse-power per hour. The vessel has also been fitted by Messrs. Siemens Bros. & Co. with an electric-lighting installation, comprising 270 20-candle-power Swan lamps; two yard-arm lights, each consisting of eight 40-candle-power Swan lamps, and two 25,000-candle-power arc lamps for search purposes. The current is supplied by three Siemens' dynamos, each driven direct by a Brotherhood three-cylinder engine.

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